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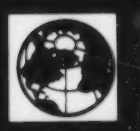

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Title: Fabrication of Shielded Metal Arc Weldments.

Final Report

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Work on the project was conducted under the auspices of the Canada Centre for Mineral and Energy Technology, Energy, Mines and Resources Canada.

DSS File No. 15SQ.23440-3-9218

DSS Contract Serial No. OSQ83-00281

CANMET Project No.

MICROMEDIA

CANMET Scientific Authority: Dr. J.E.M. Braid

Date: February 1986

124 pp

AMCA International Report No. 2-184-040/5

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SUMMARY

A series of full fusion butt joints have been welded using steel meeting the CSA G40.21 - 350 WT specification, but specially processed to meet toughness requirements for Canadian frontier exploration. The joints were welded in the vertical-up position (3G) with a number of different welding electrodes using the Shielded Metal Arc (SMAW) welding process and in thicknesses of 20mm and 40mm. A number of test pieces were machined from these joints and sent to the Physical Metallurgy Research Laboratories (PMRL) at the Canada Centre for Mineral and Energy Technology (CANMET) for testing and eventual analysis of data. In addition, similar test pieces were machined from a number of weldments whose joints had been deposited by PMRL/CANMET using the automatic Submerged Arc Welding Process (SAW). These test pieces were again forwarded to PMRL/CANMET for testing.

Finally, a total of 32 tee butt joints were fabricated in both CSA G40.21 - 350 WT and Lloyds Grade 60 in thicknesses ranging from 15mm through 100mm for use in a corrosion fatigue evaluation program now in progress at PMRL/CANMET. These joints were welded in the vertical-up position (3G), employing techniques similar to those used in equivalent European test programs.

SOMMAIRE

Une série de joints en bout a pleine fusion ont été soudé avec un métal qui rencontre la spécification du CSA G40.21-350 WT, mais spécialement produit pour donné une ténacité requise à l'exploration frontières Canadienne. Les joints ont été soudé en position montante vertical (3G), utilisant un nombre de différentes électrodes a l'arc manuel (SMAW) sur des épaisseurs de 20mm et 40mm. Un nombre de pièces d'essaie ont été taillé de ces joints et envoyé au Laboratoire de Recherche en Métallurgie Physique au Centre Canadien de la Technologie des Minéraux et de l'Énergie (CANMET) pour les essaies et l'analyse des résultats.

En plus, d'autres pièces d'essaie semblables ont été taillés d'un nombre de soudures fait par PMRL/CANMET utilisant le procédé de soudure à l'arc submergé (SAW). Ces pièces d'essaies ont aussi été acheminé à PMRL/CANMET pour les épreuves.

Finalement, un total de 32 joints tée en bout, ont été fabriqué avec les matériels CSA G40.21-350 WT et Lloyds Grade 60 en épaisseurs variant de 15mm jusqu'à 100mm pour une évaluation de corrosion de fatigue maintenant en cours à CANMET. Ces joints ont été soudé en position montante vertical (3G), utilisant des techniques semblables au programme d'essaies équivalentes Européenne.

1.0 INTRODUCTION

As part of the Federal Government's program on materials for offshore structures being performed by the Physical Metallurgy Research Laboratories (PMRL) of the Canada Centre for Mineral and Energy Technology (CANMET); a requirement existed for evaluating currently available welding consumables suitable for the welding of Carbon-Manganese steels designed for use in the offshore and Arctic environments. The fracture toughness of these weld metals was to be evaluated by correlating measured toughness with the micro-mechanisms of failure and thus methods of improving fracture toughness could be evaluated. The initial requirement was for the evaluation of the fracture toughness of welds made with the shielded metal arc process (SMAW), and this Report is concerned with the production of the test specimens, and comprises the tasks set out below.

ia) Fabrication of 20 weldments using 20 commercially available consumables in 20mm thick material.

ib) The production of test specimens from weldments given in (ia) above.

iia) The fabrication of a further eight weldments in 40mm material, utilizing four electrodes selected on the basis of preferred properties coupled with source of manufacture and obtained from test data performed on samples produced in ia and ib above. The testing of samples was performed at PMRL/CANMET.

iib) The production of test specimens from weldments given in iia above.

iii) As part of the above, a further 12 weldments, where weld metal had been deposited by the submerged arc welding process (SAW), were received from PMRL/CANMET for the production of test specimens. All these weldments were in material of 20mm thickness and the numbers and types of samples produced were similar to those removed from the 20mm plates welded with the SMAW process.

iv) Additionally, a series of double-sided, full-penetration with reinforcing fillets, T section fatigue test specimens were prepared using the SMAW process. The thicknesses of the steel plate (CSA G40.21 350 WT and LT 60), supplied by PMRL/CANMET, ranged from 15 to 100mm. A total of 32 specimens, each 200mm wide in the weld direction, were produced to weld quality standards as used by the United Kingdom Offshore Steels Research Project.

2.0 TECHNICAL PROCEDURE - BUTT WELDS

2.1 Development of a Welding Procedure for 20mm Weldments

After discussions with the Scientific Authority, a heat input window of 2 to 2.5 kJ/mm was established. A second objective was the placement of the beads in the joint gap so that an approximate mix of 50% as-welded and 50% refined weld metal occurred in the cross-section in the vicinity of the anticipated fracture path during crack tip opening displacement (CTOD) testing.

To establish a procedure within these above limits, plates of Carbon-Manganese steel were prepared and several procedures attempted using both 3.2mm and 4.0mm electrodes. The consumable used to establish these procedures was the Canadian Liquid Air E 48018-1 (Trade Name CLA LA18 Plus). The results of the above procedure verification showed that, in order to achieve an approximate 50:50 refined to unrefined weld metal microstructure coincident with the ability to be able to deposit a sound joint, the following changes had to be made to the originally defined procedure.

1. Use 3.2mm electrodes only.
2. Allow heat input upper limit to reach 2.6 kJ/mm.
3. Use six beads including the second side bead.

The above resulted in a final procedure for the 20mm plate fabrication as follows.

Preparation:	Single Vee
Included Angle:	45°
Gap:	3.2mm
Face:	1 - 2mm
Electrode ϕ:	3.2mm
Position of Welding:	Vertical-Up 3G
Weave:	8mm
Treatment:	Preheat Room Temperature Interpass 230°C Max. Backgouge to Sound Metal
Post Weld Heat Treatment:	None
Polarity	DC +ve
Heat Input:	2.0 to 2.6 kJ/mm

The pass sequence, together with heat input for each pass, was as follows:

Pass No.	Side	Amps	Av. Volts	Heat Input (kJ/mm)
1	1	110	19	2
2	1	130	19	2.6
3	1	130	19	2.6
5	1	110	19	2
6	1	110	19	2
4	2	130	19	2.6

The weld procedure specification (WPS) is given in Appendix A, which also illustrates the pass sequence.

2.2 Fabrication of 20mm Weldments

As given in the introduction, the objectives of the overall program were to evaluate the fracture toughness of weld metals in the as-welded condition, utilizing currently available consumables. Candidate

consumables had been selected from various suppliers, both in Canada and Europe. The following is a breakdown of suppliers and their country of origin.

Manufacturer	Country of Origin	Number of Consumables Supplied and Tested
ESAB	Sweden	4
Canadian Liquid Air (CLA)	Canada	3
Hobart	Canada	4
Lincoln	Canada	4
Murex (Now ESAB)	UK	3
Oerlikon	UK/Switzerland	2
	Total	20

Each of the above consumables was given a unique number and a summary of electrode type, classification and manufacturer is given in Table 1.

Each weldment was welded in the vertical-up position (3G), the plates being restrained in a prefabricated jig as shown in Figure 1. Prior to each contract weld being deposited in the 1220mm long joint, each particular electrode was deposited into a trial joint for the following reasons:

a) To allow the welding operator to become adjusted to each electrode, as operating characteristics can vary markedly.

b) To allow sectioning of the trial weld to check both quality and consistency of procedure with that defined.

By adopting the above approach, the welding operator was familiar with the electrode prior to deposition into the contract joint.

As part of the quality requirements of the project, a separate unique control document was issued for each of the 20 weldments containing important check and inspection points. A sample is given in Figure 2. Heat input was controlled by depositing a set electrode length into the joint over a set period of time. To achieve this, the joint itself was marked into 25mm spacings and the welding operator employed a hearing aid system connected to an electronic buzzer. The buzzer was pre-set to operate at 30 second intervals, thus allowing the operator to control his travel speed very accurately.

Whilst the objectives of the program were to evaluate fracture toughness, it was felt that the operator appeal of each electrode should also be studied. Whilst this was clearly subjective and only one welding operator was used, it did provide information which could be used to decide which electrode to test in the 40mm plates, particularly if there was no clear advantage in data accumulated from both the impact and fracture toughness results.

The operator appeal data is tabulated in Table 2, and a resume follows in the Technical Discussion. All control documentation is given in Appendix B.

2.3 Production of Samples from 20mm Plate for Testing

The requirements for test samples produced from the 20mm plates were as follows:

Test Piece	Per Plate	Total from 20 Plates
Tensile	4	80
Impact	18	360
CTOD	9	180
Chemistry Sample	1	20
Macro	2	40

The completed weldments were flame cut into blanks in accordance with written procedures. Tensile and CTOD specimens were then given a hydrogen diffusion treatment of 24 hours at 93°C (200°F), and all samples saw-cut to final size prior to transmittal to the machining area. During every cutting process, individual identification numbers were transferred.

Finally, on completion of machining, all samples were routed to the Quality Control/Inspection area for final inspection prior to delivery to PMRL/CANMET.

Final machined pieces were required to meet the following specifications:

Tensiles:	.250 Reduced Section
Impacts	ASTM A370
CTOD's	BS 5762: 1979

Figures showing final machined sizes are given in Appendix C and release documents for the hydrogen diffusion treatment are given in Appendix D.

2.4 Analysis of 20mm Data by PMRL/CANMET

On the basis of the toughness information given primarily by impact data, the following electrodes were selected for welding in Task ii.

Manufacturer	Classification and Type
Canadian Liquid Air (CLA)	E48018 LA 18 Plus
Canadian Liquid Air (CLA)	E55018 C1
Murex (Now ESAB)	E48016 STF
ESAB	E55018 C OK73.68

The original intent was to select only two (2) consumables from the twenty (20) tested and to deposit these in 40mm and 100mm plate conforming to CSA G40.21 - 350 WT, testing of samples being in the as-welded condition only. However, after data analysis by PMRL/CANMET, it was decided to test the four electrodes given above.

In addition, the scope was changed to include the testing of prepared samples in both the stress-relieved and as-welded condition, but in 40mm plate only.

2.5 Development of a Welding Procedure for 40mm Weldments

The original concept required a double vee joint with heat input being controlled in the 2 kJ/mm regime, but within the bounds of normal fabricating experience. However, the requirement for impact specimens to be taken from the subsurface and in the vicinity of the root dictated that a single vee groove be used. The subsurface and root impacts were to be taken through the same section due to restrictions on plate availability.

As with the 20mm plate, procedures were developed using non-contract material and cross-sections submitted for approval. The final welding procedure was as follows, the welding procedure specification (WPS) being given in Appendix A.

Preparation:	Single Vee
Included Angle:	45°
Gap:	3.2mm
Face:	1 - 2mm
Electrode ϕ:	3.2 and 4.0mm
Position of Welding:	Vertical up (3G)
Weave:	8mm for 3.2mmϕ 10mm for 4.0mmϕ
Treatment:	100° Preheat min. 250°C Interpass max. Backgouge to Sound Metal

Post Weld Heat Treatment:	590°C for 2 hours for 4 plates None for balance of additional 4 plates
Polarity	DC+ AC for Murex STF
Heat Input:	≅ 2 kJ/mm + 10% -0

The pass sequence was as follows and a typical deposit diagram is shown in the WPS given in Appendix A.

Pass No.	Side	Electrode ϕ	Current	Av. Volts	Heat Input kJ/mm +10% -0
1-4 inc.	1	3.2mm	120	21	2
6-11 inc.	1	4.0mm	160	21	2
12-17 inc.	1	3.2mm	120	21	2
5	2	3.2mm	120	21	2

2.6 Fabrication of 40mm Weldments

As described in Section 2.1, each procedure utilizing different electrodes was first performed on non-contract plate to allow operator familiarization and sectioning to inspect for weld quality. All welds were again deposited in the 3G vertical-up position, each weldment being restrained in a prefabricated jig as shown in Figure 1. The unique identification appears in Table 3, and all control documentation is produced in Appendix B.

2.7 Production of Samples from 40mm Plate for Testing

The requirement for test samples produced from each 40mm plate was as follows:

Test Piece	Per Plate	Total from 8 Plates
Tensile	4	32
Impact	18 subsurface 18 root	288
CTOD	6	48
Chemistry Sample	1	8
Macro	1	8
Discard (apx. 200mm) for PMRL Metallurgical Studies	1	8

The cutting, hydrogen diffusion, machining and quality control steps followed a logical sequence as described under Section 2.3. On final inspection clearance, all samples were delivered to PMRL/CANMET for testing.

2.8 Machining of Samples from 20mm Weldments made with Submerged Arc Deposits

As part of this contract, a total of 12 weldments containing welds deposited by 12 different combinations of submerged arc wire and flux were received from PMRL/CANMET for the machining of test specimens.

The numbers of samples were as follows:

Test Piece	Per Plate	Total from 12 Plates
Tensile	4	48
Impact	18	218
CTOD	9	108
Chemistry	1	12
Macro	2	24

These samples followed the same cutting, hydrogen diffusion, machining and inspection route as previously described and were delivered to PMRL/CANMET on acceptance.

3.0 TECHNICAL PROCEDURE AND FABRICATION OF TEE BUTT WELDMENTS

As part of the ongoing analysis into the fatigue of offshore structures, a series of double sided, full penetration with reinforcing fillets, tee butt sections were prepared utilizing the shielded metal arc process (SMAW). A total of 32 specimens were produced in various thicknesses and with two different sources of steel viz:

Plate Thickness (mm)	Steel Specification	Supplier Via Courier	Number
15	CSA G40.21-350 WT	Stelco	4
25	Lloyds LT60	Algoma	10
50	Lloyds LT60	Algoma	4
75	Lloyds LT60	Algoma	10
100	CSA G40.21-350 WT	Stelco	4

The 15mm plate from Stelco was continuously cast with titanium additions, whilst the Algoma steel was ingot cast with calcium additions. Similarly, the 100mm plate from Stelco was ingot cast and contained titanium.

These particular tee joints had to be manufactured to the same specification as those produced for the United Kingdom Offshore Steels Research Program (UKOSRP). The essential component of this specification was the condition of the weld toes of the reinforcing fillets, wherein each particular weld in a particular steel thickness should have a toe profile that was controllable. Since the objective of the fatigue program was to assess the fatigue properties of the base material, then it was of great importance to produce an acceptable

profile, so that the initiation of a fatigue crack, which would occur at the toe, would be reasonably controlled.

To this end, the procedure adopted in the UKOSRP program was used, the major components being:

1) Restrictions on Toe Undercut

2) Control of Toe Profile by Satisfactory 'Dime Testing'.

In all cases, the weld toe angle would have to conform to the 'dime' test as indicated in Figure 3. That is, a disc of radius t/2 (the radius being a minimum of 8mm and a maximum of 25mm) would be placed against the buttering weld run and the longitudinal plate, and a 1mm diameter wire should not pass between the disc and the buttering run in the weld toe region. In all cases, the maximum amount of undercut at the weld toe could not exceed 0.25mm.

An additional problem in satisfying the above test was the fact that the joints would have to be welded in the vertical-up (3G) position. An extensive amount of operator training was performed to establish procedures for the tees and the requirements of the dime test.

All 32 tees were fabricated by using 3.2mm diameter electrodes in the root areas, filling with 4.0mm diameter on 50mm and up; and capping with stringers using the smaller diameter rod. All electrodes were of the E48018 classification. A list of Tees manufactured is given in Table 4.

The total weld length was 250mm (10"), and the final size of 200mm (8.0") was achieved by milling each end. The milling was a requirement of the contract and was performed to reduce edge effects during fatigue testing. The final operations were the drilling of holes, one in the vertical member and one in the horizontal, and subsequent quality control release.

Details of welding procedures and the dimensions of the tees are given in Appendix E.

TECHNICAL DISCUSSION

The requirement for a heat input in the 2 kJ/mm range for the 20mm weldments had been decided based on the data existing in the literature for electrodes and steels of the type being studied. A heat input of this magnitude was analysed as giving the preferred toughness based on microstructural components for the range of deposited chemistries, and the quantities of refined vs. unrefined weld metal.

As discussed in Section 2.1, the final heat input was in the 2.0 to 2.6 kJ/mm range utilizing the smaller diameter electrode (3.2mm). This was decided based upon the required mix of refined vs. unrefined weld metal, which was approximately 50:50 over the expected fracture path. The advantages of utilizing the smaller diameter electrode in this series of tests were improvements in control by virtue of 6 passes against 5 passes, as developed utilizing both diameters (3.2 and 4.0mm). The additional pass reduced the need for controlled weaving during 3G welding, and thus allowed greater control over heat input, layer thickness, etc.

Of the twenty plates welded in the first series of tests, i.e. utilizing 20mm plate, all but one joint was deposited with exactly the same procedure.

Since this welding procedure was defined using a particular brand and classification of consumable, it was expected that difficulties would occur with certain electrodes in trying to maintain a rigid procedure,

especially since welding was being performed in the vertical-up (3G) position. Nearly all the contract electrodes suffered from 'finger-nailing' in the root pass, and many had poor wash characteristics such that slag trapping in the side walls became an increased possibility, especially in the root, as the backgouging depth on the second side was restricted by procedure. Electrode #13 was a major concern as the arc was very erratic and slag was readily visible after backgouging, so that it was necessary to slightly overgouge to remove this from approximately 600mm of the plate. Thus, in order to be able to fill the second side in one pass, it was necessary to place a very small stringer bead in this 600mm length prior to fill, this stringer being remelted by the final capping pass. This was the only deviation from procedure during the fabrication of the 20mm weldments. The bead placement is illustrated in Appendix A.

Since it had been recognized that the operating characteristics of the electrodes would differ over the range of consumables used, and that this would be more noticeable due to the position of welding, it was decided to rate the electrodes from an operator performance viewpoint.

There are a number of inherent problems when assessing operating characteristics which, in the case of this program, can be listed as follows:

1. The assessment is purely subjective and represents the operator's opinion, based on his own manipulative skills and experience.

2. In order to be able to effectively repeat the welding procedure from weldment to weldment, only one welding operator was used throughout the program. However, the operator was a very experienced, highly skilled person. In terms of assessment, it would have been preferable to use up to three operators, but this may have led to inconsistencies in the deposition of the weld metal. The objectives of the program were fracture toughness assessment, therefore, the control of procedure was of prime importance.

3. Electrodes assessed against each other and not any known standard.

An examination of Table 2 shows no trend other than the fact that, in general, the E480XX series were easier to control than the E550XX series. The best operating electrodes were deemed to be the CLA E48018-1 and the Murex E48016-C1L operating on DC positive polarity, and the Murex E48016 (Ferex) operating on AC current. Those electrodes that were found the most difficult to control were the aforementioned electrode #13, the Lincoln E48018 (LH75), the ESAB E48106, the CLA E44018-C1 and the Murex 55018-C2, all operating on DC positive. In the case of the Lincoln E48018 (LH75) it was felt that the flux coating may not have been bonded correctly, due to the severe fingernailing. The flux on the Lincoln E48018 (LH78) was definitely damaged, although this did

not effect the operating characteristics as much as the LH75. In both these cases, the above assessment may not be accurate, as this flux bonding problem may not be representative of the product, but just occurring in the batches received for this program.

In terms of electrode selection for the 40mm weldments, two of the electrodes chosen on the basis of their toughness properties were those deemed to have good operating characteristics, and two were in the more difficult category.

Excellent: CLA E48018-1 and Murex E48016 STF

Difficult: CLA E55018-C1 and ESAB E48016

The same observations during the welding of the 40mm plate were noted by the welding operator.

In the case of the Tee Butt welds, the requirement was for the use of E48018 type electrodes only. A total of 32 Tees were required by contract and only one tee in 25mm material was rejected on weld quality grounds due to excessive undercut at the toe and generally inferior capping pass profile. This was replaced by an acceptable tee. With regard to the toe profile required by the 'dime test'; this was found to be readily achievable in the 3G position once the operator had undertaken sufficient practice and had become aware of the requirements.

TABLES

TABLE 1: UNIQUE IDENTIFICATION OF COMPLETED 20mm WELDMENT

MATERIAL	t(mm)	JOINT	CONSUMABLE		WELDING
			TYPE	NO.	I.D. NO.
350 WT	20	BUTT	ESAB E48018-G	1	1
"	"	"	ESAB E48018-1	2	2
"	"	"	ESAB E48016	3	3
"	"	"	ESAB E48018-C1	4	4
"	"	"	CLA E48018-1	5	5
"	"	"	CLA E55018-C1	6	6
"	"	"	CLA E55018-C3	7	7
"	"	"	HOB-LMPE48018	8	8
"	"	"	MUREX 55018-C2	9	9
"	"	"	HOB E55018-C1	10	10
"	"	"	HOB E55018-C2	11	11
"	"	"	HOB E55018-C3	12	12
"	"	"	LINCOLN A (LH 75)	13	13
"	"	"	LINCOLN B (LH 78	14	14
"	"	"	JET LH55018-C1	15	15
"	"	"	JET LH55018-C3	16	16
"	"	"	MUREX E48016-C1L	17	17
"	"	"	MUREX FEREX STF (E48016)	18	18
"	"	"	OERLIKON E55018 G	19	19
"	"	"	OERLIKON E48018-1	20	20

Lincoln A = Lincoln E48018 (LH75)

Lincoln B = Lincoln E48018 (LH78)

TABLE 2: SUMMARY OF ELECTRODE PERFORMANCE DURING VERTICALLY UP (3G) WELDING

ID. NO.	MANUFACTURER	CLASSIFICATION	OPERATING CHARACTERISTICS	ABILITY TO CONTROL	FINGERNAILING	OTHER COMMENTS
1.	ESAB	E48018-G	Good	Good	No	Generally Satisfactory
2.	ESAB	E48018-1	Good	Good	No	Generally Satisfactory
3.	ESAB	E48016	Below Average	Difficult	No	Very fast burning flux. Very difficult to control in root.
4.	ESAB	E55018-C1	Unstable Arc	Difficult	Yes In Root	Difficulty in controlling weld pool.
5.	CLA	E48018-1	Good	Excellent	No	Deemed to be generally better than most with excellent wash in.
6.	CLA	E55018-C1	Below Average	Difficult	Yes In Root	Poor wash in and inferior to Electrode #5.
7.	CLA	E55018-C3	Below Average	Average	Yes In Root	Improved control over #6, but not as good as #5.
8.	Hobart	E48018 (LMP)	Average	Average	Very Bad in Root Only	Good wash in achieved
9.	Murex	E55018-C2	Average	Difficult	Yes In Root	Fast burning flux giving difficult control.
10.	Hobart	E55018-C1	Good	Good	Slight Tendency	Need to hold very close arc to overcome fingernailing.

TABLE 2 (CONT.): SUMMARY OF ELECTRODE PERFORMANCE DURING VERTICALLY UP (3G) WELDING

ID. NO.	MANUFACTURER	CLASSIFICATION	OPERATING CHARACTERISTICS	ABILITY TO CONTROL	FINGERNAILING	OTHER COMMENTS
11.	Hobart	E55018-C2	Good	Good	Slight Tendency	Need to hold close arc for fingernailing. Good wash in characteristics
12.	Hobart	E55018-C3	Good	Good	No	Comparable, but felt better than #10 and #11.
13.*	Lincoln	E48018 (LH75)	Inferior	Inferior	Yes Extreme	Very difficult to control. in root.
14.**	Lincoln	E48018 (LH78)	Average	Average	Yes	Flux did not appear to be bonded correctly with noticeable damage to flux
15.	Lincoln	E55018-C1	Good	Good	Minor	Generally Satisfactory
16.	Lincoln	E55018-C3	Good	Good	Minor	Generally Satisfactory
17.	Murex	E48016-C1L	Very Good	Excellent	No	Deemed to be one of the better electrodes
18.***	Murex	E48016 (Ferex STF)	Inferior	Difficult	No	Poor wash in and flow characteristic
19.	Oerlikon	E55018-G	Good	Good	No	Deep flux burden and more spatter but generally satisfactory
20.	Oerlikon	E55018-1	Good	Good	No	As above more spattering, but puddle easier to control than #19.

* It was suspected in both above cases that these electrodes had coating problems due to
** manufacture. The particular batch tested may, therefore, not be representative.

*** This electrode was operated on DC+ to maintain procedural consistency, but it is recommended for use on AC. Its operating characteristics on AC were found to be superior.

TABLE 3: UNIQUE IDENTIFICATION OF COMPLETED 40mm WEDLMENTS

PROGRAM	MATERIAL	CONSUMABLE		WELDING I.D. NO.
		CLASSIFICATION	TYPE	
BN18	350 WT	E7018	Canadian Liquid Air LA 18 Plus	21a 21b
BN18	350 WT	E8018-C1	Canadian Liquid Air E8018-C1	22a 22b
BN18	350 WT	E7016	Murex STF	23a 23b
BN18	350 WT	E8018-C1	ESAB OK 73.68	24a 24b

a = As Welded

b = Post Weld Heat Treated

TABLE 4: UNIQUE IDENTIFICATION OF COMPLETED TEE BUTT WELDMENTS

Weld I.D. No.	Material Type	Material Thickness (mm)	Delivered
25	350 WT	15	Yes
26	350 WT	15	Yes
27	350 WT	15	Yes
28	350 WT	15	Yes
29	LT 60	25	Yes
30	LT 60	25	Yes
31	LT 60	25	Yes
32	LT 60	25	Yes
33	LT 60	25	Yes
34	LT 60	25	Yes
35	LT 60	25	Yes
36	LT 60	25	Yes
37	LT 60	25	No Defective
37a	LT 60	25	Yes
38	LT 60	25	Yes
39	LT 60	50	Yes
40	LT 60	50	Yes
41	LT 60	50	Yes
42	LT 60	50	Yes
43	LT 60	75	Yes
44	LT 60	75	Yes
45	LT 60	75	Yes
46	LT 60	75	Yes
47	LT 60	75	Yes
48	LT 60	75	Yes
49	LT 60	75	Yes
50	LT 60	75	Yes
51	LT 60	75	Yes
52	LT 60	75	Yes
53	350 WT	100	Yes
54	350 WT	100	Yes
55	350 WT	100	Yes
56	350 WT	100	Yes

FIGURES

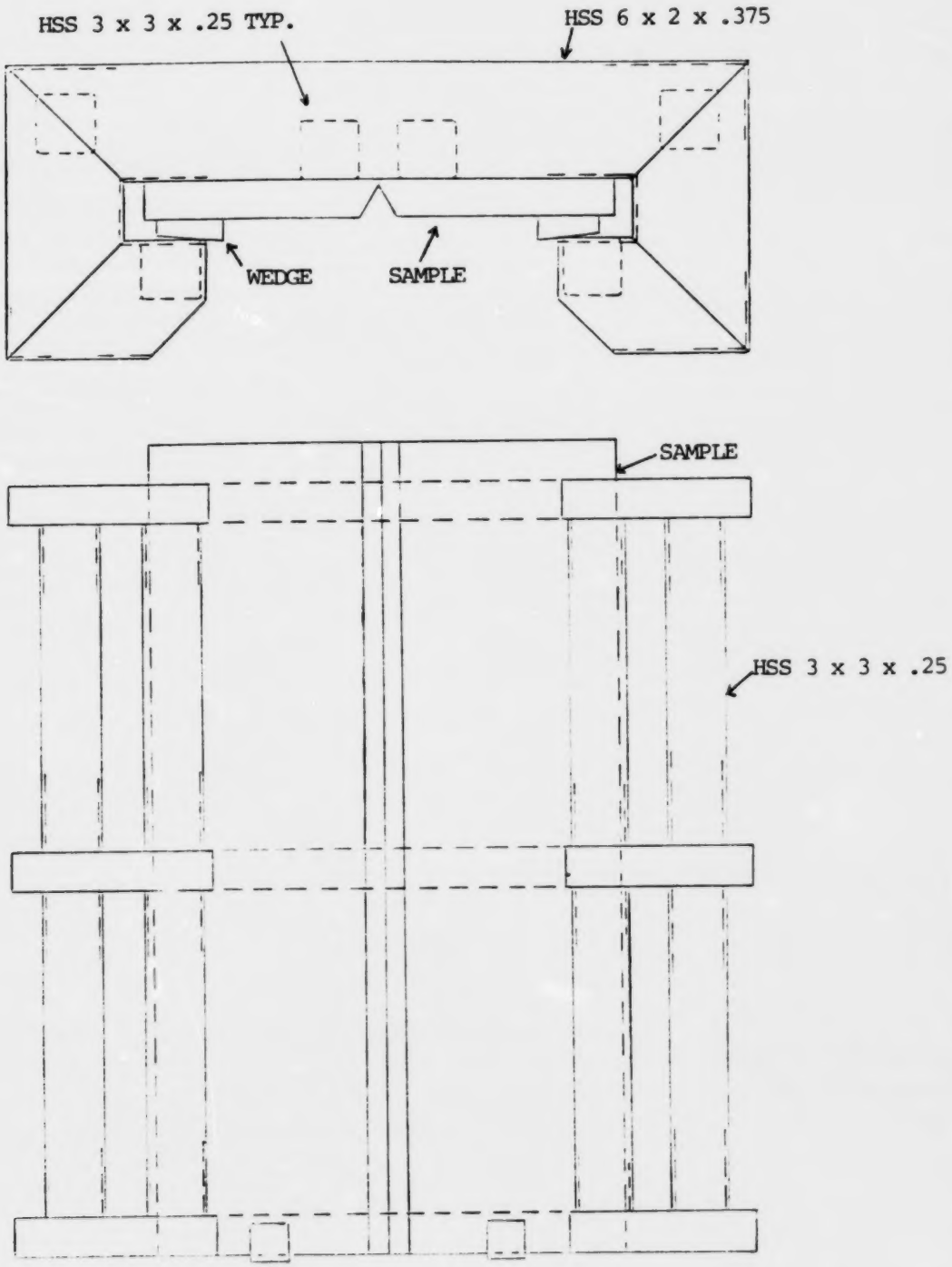


FIGURE 1: Prefabricated Restraint Jig

DSS CONTRACT NO: _____
PROJECT NO: _____
SERIES NO: _____

WELDING DATA AND QC SHEET

POWER SOURCE: _____
WELDING PROCESS: _____
WELDING POSITION: _____

ELECTRODE IDENTIFICATION NO.: _____
PLATE IDENTIFICATION NO.: _____

ELECTRODE TYPE: _____
ELECTRODE DIAMETER(mm): _____
PLATE TYPE: _____
PLATE THICKNESS(mm): _____

WELDING PARAMETERS

CURRENT: _____
VOLTAGE: _____
TRAVEL SPEED(mm/min): _____
RUN OUT LENGTH(mm) _____
HEAT INPUT _____

WFS: _____
POLARITY: _____
PREHEAT: _____ °C
INTERPASS HEAT: _____ °C
SHIELDING GAS: _____
FLOW RATE: _____

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL YES
USE OF RESTRAINTS YES

STAMP "T" FOR PLATE TOP

QUALITY CONTROL HOLD POINTS

		SIGNATURE
FIT-UP PRIOR TO WELDING	YES	_____
BACKGOUGE CHECK	YES	_____
DIME TEST	YES	_____
FINAL INSPECTION	YES	_____

JOINT GEOMETRY

LAYER NO.	PASS NO.	ELECTRODE DIAMETER

WELDING TECHNICIAN'S SIGNATURE: _____ DATE: _____

WELDING SUPERVISOR'S SIGNATURE: _____ DATE: _____

QC INSPECTOR'S SIGNATURE: _____ DATE: _____

FIGURE 2: Sample QC Document

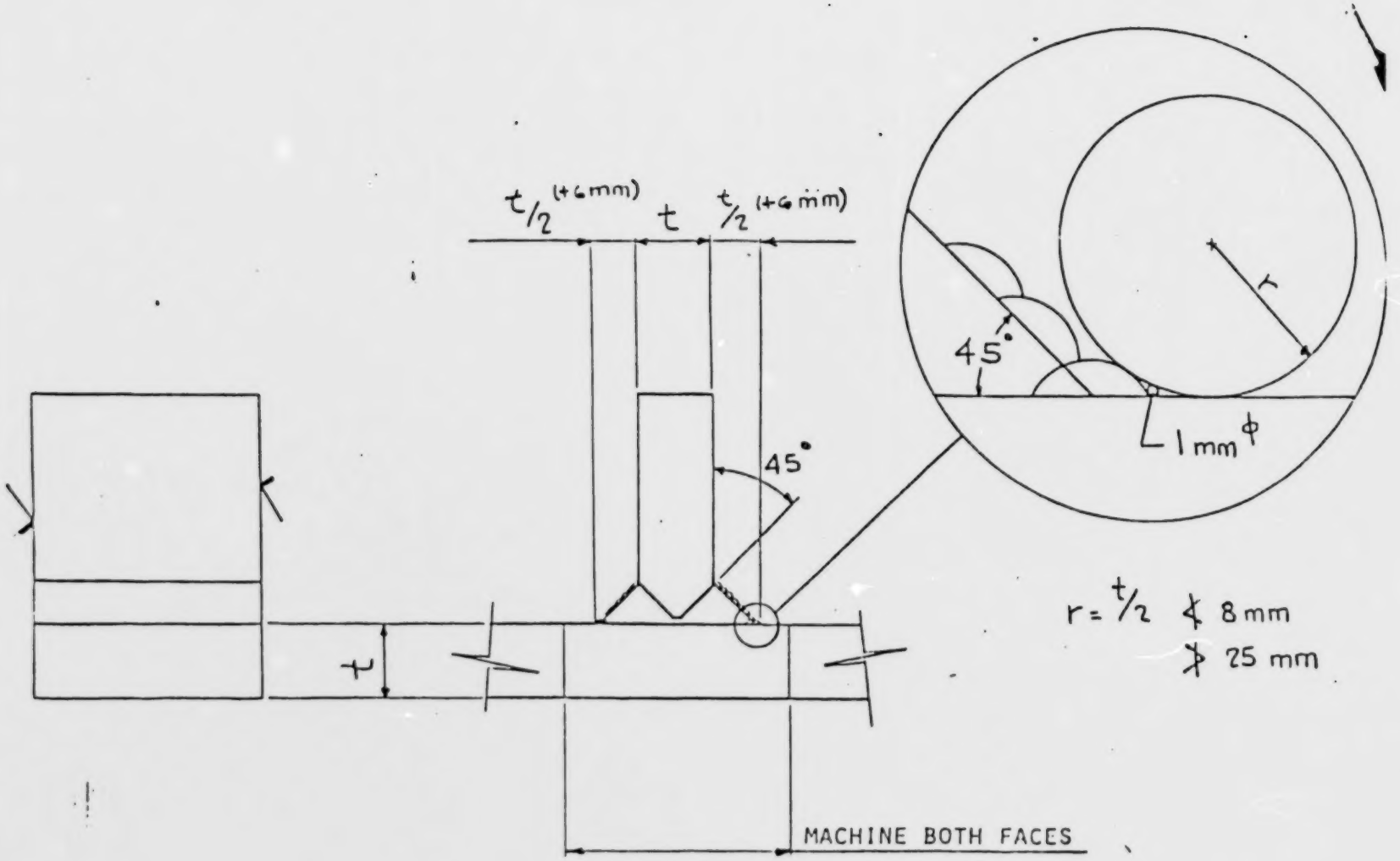


FIGURE 3: Requirements of Dime Test.

APPENDIX A

WELDING PROCEDURE SPECIFICATION

20 AND 40MM BUTT JOINTS - TEE BUTTS

WELDING DATA

DATA SHEET	WELDING PROCEDURE SPEC'N
See 2-184-040-099 BN18 Series 1-20	WPS BN18-1

PROCESS: Shielded Metal Arc (SMAW)

MATERIAL SPEC. CSA G40.21 - 350 WT

see attached

POSITION 3G

PREHEAT TEMP. Room Temp.

INTERPASS TEMP. 230°C

ROOT TREATMENT Backgouge to Sound Metal

FILLER METAL:

TRADE NAME Test Electrodes. See Unique List.

FLUX:

TRADE NAME & PARTICLE SIZE N/A

GAS:

SHIELDING GAS		AT	CFH
TRAILING GAS	N/a	AT	CFH
BACKING GAS		AT	CFH

JOINT GEOMETRY

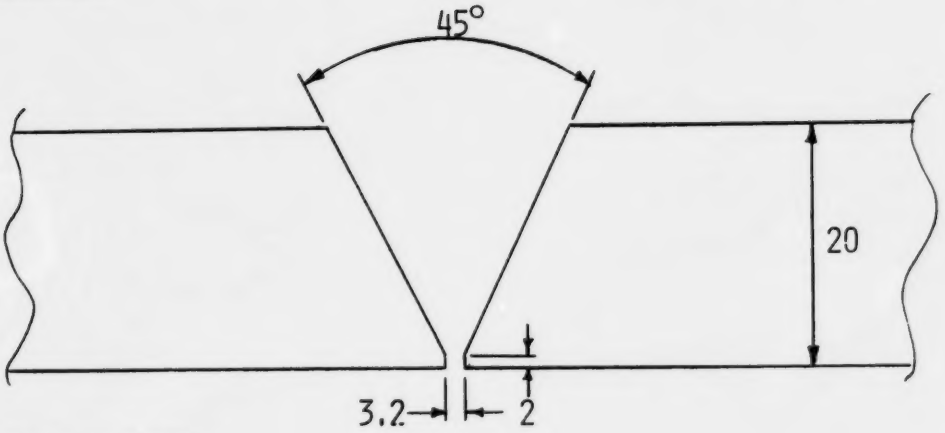
T	SIDE	LAYER	PASS	AMPS ±	WIRE FEED SPEED I.P.M.	VOLTS ±	TRAVEL SPEED MM/M ±	ELECTRODE DIA.	ELECTRODE TYPE	ELECTRODE ESO	ELECTRODE POLARITY
20mm	1	1	1	110		19	63	3.2	E480XX	N/A	DC+
	1	2	2	130		19	75	3.2	or	N/A	DC+
	1	3	3	130		19	57	3.2	E550XX	N/A	DC+
	1	4	5-6	110		19	63	3.2		N/A	DC+
	2	1	4	130			57	3.2		N/A	DC+

NOTES

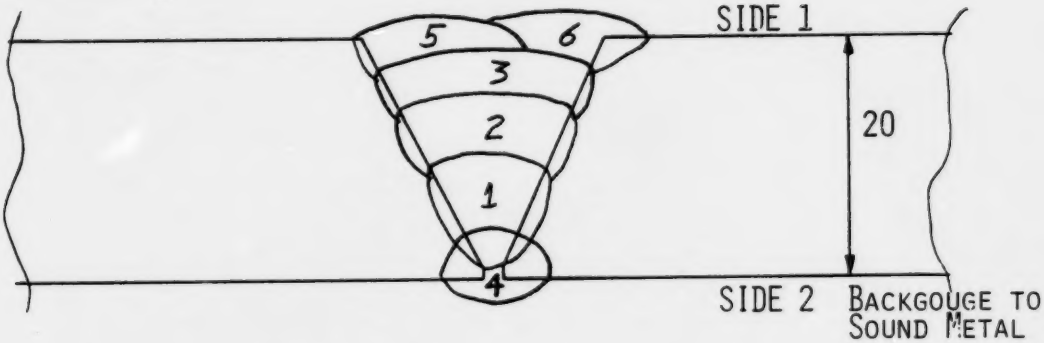
ISSUED BY	APPROVED BY	CONTRACT
G. Proulx	M.J. Pate	2-184-040/099
DATE 18/4/84	DATE April 84	

CONTRACT #2-184-040-099
WPS BN18-1

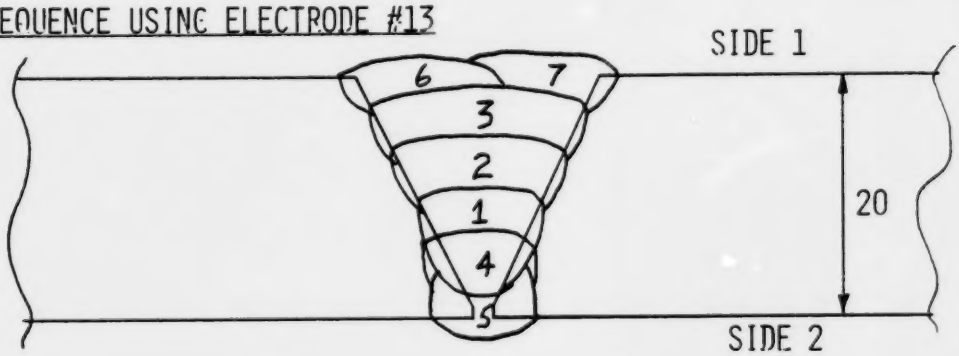
BUTT JOINT (MM)



ADAPTED PASS SEQUENCE



PASS SEQUENCE USING ELECTRODE #13



PASS 4 - VERY SMALL STRINGER BEAD DUE TO EXCESS BACKGOUGE REQUIRED TO REMOVE MAJORITY OF SLAG.

WELDING DATA

DATA SHEET	WELDING PROCEDURE SPEC'N
See 2-184-040-099 BN18 Series 21A-24B	WPS BN18-2

PROCESS: Shielded Metal Arc (SMAW)

MATERIAL SPEC. CSA G40.21 - 350 WT

see attached

POSITION 3G

PREHEAT TEMP. 100°C

INTERPASS TEMP. 250°C

ROOT TREATMENT Backgouge to Sound Metal

FILLER METAL:
TRADE NAME Test Electrodes - See Unique List

FLUX:
TRADE NAME & PARTICLE SIZE N/A

GAS:

SHIELDING GAS	N/A	AT	CFH
TRAILING GAS		AT	CFH
BACKING GAS		AT	CFH

JOINT GEOMETRY

T	SIDE	LAYER	PASS	AMPS ±	WIRE FEED SPEED I.P.M.	VOLTS ±	TRAVEL SPEED MM/MIN ±	ELECTRODE DIA.	ELECTRODE TYPE	ELECTRODE ESO	ELECTRODE POLARITY
40mm	1	1-4	1-4	120		21	75	3.2	E480XX		DC+
	1	5-7	6-11	160		21	100	4.0	or		DC+
	1	8-9	12-17	120		21	75	3.2	E550XX		DC+
	2	1	5	120		21	75	3.2			DC+

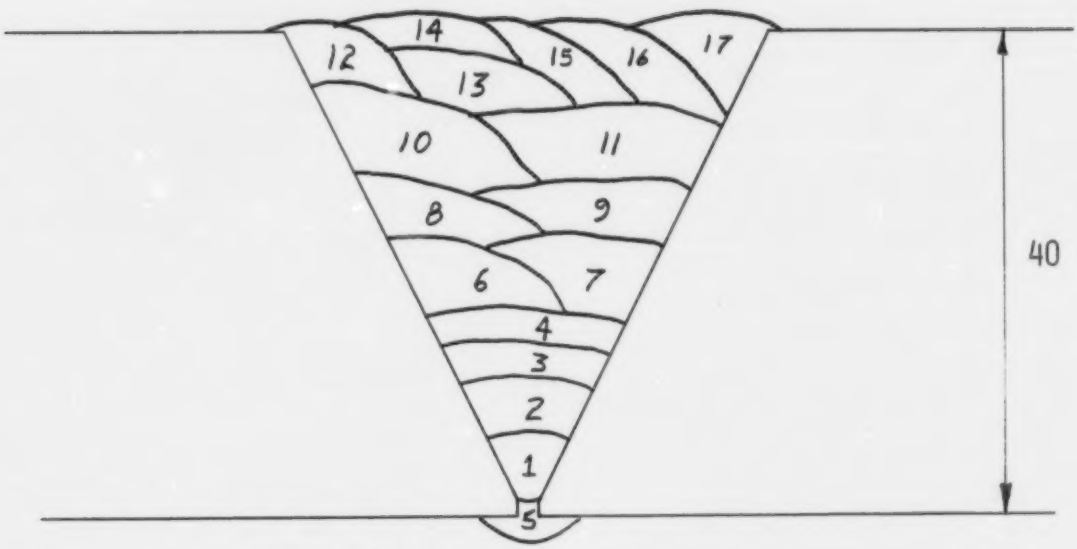
NOTES
* One electrode Murex - STF E48016 Type to be operated on AC current

ISSUED BY	APPROVED BY	CONTRACT
G. Proulx	M.J. Bates	2-184-040/099
DATE 15/4/85	DATE April 85	

BUTT JOINT (MM)

CONTRACT #2-184-040-099
WPS BN18-2

ADAPTED PASS SEQUENCE



WELDING PROCEDURE SPECIFICATIONS

CLIENT: Department of Supply and Services for CANMET EMR

AMCA INTERNATIONAL Ref. No. BN 18

Contract No. 2-184-040-099

DSS File No. 15SQ-23440-3-9218

Prepared by G. Prouty

Approved by M. J. Pate

Welding Procedure Specification (WPS)

Welding Procedure Specification for the Welding of Butt Joints by the Manual Shielded Metal Arc Process in G40.21 Grade 350 WT Material and Lloyds LT60

1. Scope

This specification covers welding and related operations for the fabrication of Butt Joints and is generally in accordance with CSA Standard W59-1982 'Welded Steel Construction' (Metal Arc Welding).

2. Related Specifications

CSA W59-1982	Welded Steel Construction (Metal Arc Welding)
CSA W48.1-M1980	Mild Steel Covered Arc Welding Electrodes
CSA W48.3-M1982	Low-Alloy Steel Covered Arc Welding Electrodes
CSA W47.1-1973	Certification of Companies for Fusion Welding of Steel Strucutres
UKOSRP	United Kingdom Offshore Steels Research Project - Guidelines
CSA G40.21	Structural Quality Steels

3. Welding

Welding will be performed by the Manual Shielded Metal Arc Process.

4. Base Metal

The base metal shall conform to the requirements of CSA G40.21 Grade 350 WT 'Weldabale Notch Tough Steel' or the requirements of 'Lloyds LT60'.

5. Base Metal Thickness

This specification covers the welding of the base metal in thicknesses up to 100mm.

6. Consumables

a) Electrodes shall be basic electrodes generally in accordance with the requirements of CSA Standard W48.1 and 48.3, and shall be of the EXX16 or EXX18 classification.

b) Storage and conditioning of electrodes shall be carried out in accordance with the requirements shown in Section 22 of this specification.

7. Weld Preparation

The welding preparation shall conform generally to the joint types M2-1, M3-2 and M5-2.

8. Position of Welding

Welding shall be in the vertical up welding position (3G).

9. Electrode Size and Weave

a) The electrode diameters shall be as follows:

Root Run	3⅛mm diameter electrode
Fill to Cap	3⅛ or 4mm diameter electrodes

b) Maximum permissable weave allowed during Vertical Welding

3⅛mm	Max. Weave = 8mm
4mm	Max. Weave = 10mm

c) Heat Input will be controlled when required, by specifying a minimum run out length for each electrode diameter.

10. Preparation

Edges and surfaces of parts to be welded shall be prepared by flame-cutting. They shall be smooth, uniform and free from fins, tears, cracks and other defects which would adversely affect the quality or strength of the weld. Surfaces to be welded shall also be free, within two inches of any weld location, from loose or thick scale (except for tightly adhering small islands of scale), slag, rust, paint, grease, moisture and other foreign material that will prevent proper welding or produce objectionable fumes.

11. Run-Off Plates

Run-off plates used for the welding may be any of the steels or their equivalents as defined in CSA W59.

12. Preheat

a) Prior to tacking or welding, the base metal shall be preheated and the heat maintained during welding at the minimum temperature shown in the following table.

Up to 15mm inc.	None*
Over 15mm to 38mm inc.	15°C
Over 38mm to 60mm inc.	70°C
Over 60mm	120°C

*When the base metal temperature is below 0°C, preheat the base metal to 15°C and maintain this temperature during welding.

b) Preheating will be accomplished by means of flame torches.

c) Preheating shall consist of heating a band of the base metal equal to the thickness of the base metal, but not less than 3 inches on either side of the joint to the desired temperature, and maintaining this temperature during welding.

13. Distortion Control

a) In assembling and joining, the procedure and sequence shall be such as will minimize distortion and shrinkage.

b) In so far as practicable, all welds shall be deposited in a sequence that will balance the applied heat of welding while the welding progresses.

14. Electrical Characteristics

The type of current, polarity and typical current value for any electrode class or size shall be substantially as shown in the following table, but the current for any specific electrode used may be altered to within 15% above or below the typical value.

ELECTRODE		ELECTRODE POLARITY		ELECTRODE DIA.	BUTT WELDS TYPICAL CURRENT	
"F" GROUP	CLASS	AC	DC	SIZE mm	1G 2G Tacking only	Vertical 3G
4	E-XX16	Yes	+VE	3.4 4	120 170	110 155
4	E-XX18	Yes	+VE	3.4 4	140 200	120 165

15. Workmanship

All welding and its related operations shall be performed in accordance with good welding practice and within the recommendations and limitations outlined in CSA W59-1982.

16. Appearance of Welding Layers

The welding current and the manner of depositing the weld metal shall be such that undercutting on the side walls of the welding groove or the adjoining base material shall be limited to the following:

a) for straight butt welds = .75mm

b) For areas subject to fatigue testing = .25mm

17. Cleaning

Cleaning of previously deposited layers shall be done by wire brushing or by mechanical means, if necessary, to remove all traces of slag from the deposit, before the next successive bead is applied.

18. Defects

Surface defects appearing on any weld bead shall be removed by grinding and rewelded, if necessary, before the next layer is deposited.

19. Treatment of Underside of Welding Groove

The root of the joint shall be arc-gouged to produce a groove contour substantially conforming to the prequalified single U-joint, and its depth shall be adequate to ensure complete penetration into the previously deposited weld metal.

20. Finished Joint Profile

20.1 Fatigue Situation

The weld profile shall conform to a 45° reinforcing fillet as shown in Figure 1. Weld leg lengths shall not fall ouside the dimensions shown and the capping runs shall be carried out by first depositing a buttering run, to give a good weld toe angle and then filling in the bulk of the capping runs. In all cases, the weld toe angle shall conform to the "dime" test as indicated in Figure 1. That is, a disc of radius t/2 (but the radius shall be a minimum of 8mm and a maximum of 25mm) shall be placed against the buttering weld run and the longitudinal plate, and a 1mm diameter wire shall not pass between the disc and the buttering run in the weld toe region. In all cases, the maximum amount of undercut at the weld toe shall not exceed 0.25mm.

20.2 Static Situation

For those joints being welded which are not subject to fatigue testing, finished joint profile shall be as per CSA W59.

21. Post Weld Heat Treatment

Post weld heat treatment is not required.

22. Storage and Conditioning of Electrodes

1. Basic Electrodes - All basic electrodes should be delivered in hermetically-sealed containers which do not show evidence of damage.

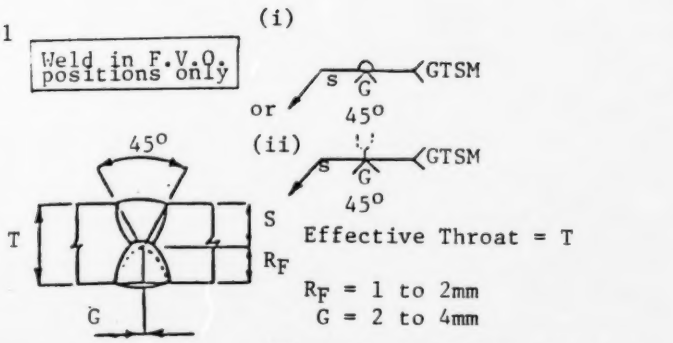
Immediately after being removed from containers, electrodes shall be stored in ovens held at a temperature of at least 120°C for 48 hours.

Basic electrodes of E70 classification that are not used within 4 hours after removal from ovens shall be discarded. Basic electrodes of the E80 classification that are not used within 2 hours after removal from ovens shall be discarded.

Any electrode container showing evidence of damage will be subject to discussion between AMCA and CANMET/EMR with respect to reclaimation procedure.

M2-1

Weld in F.V.O. positions only



Effective Throat = T

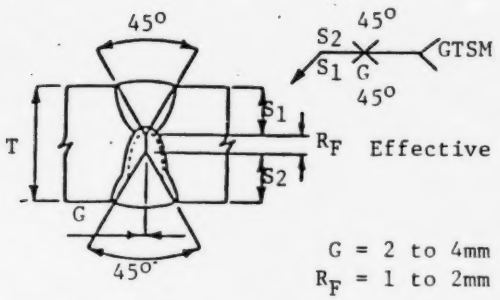
R_F = 1 to 2mm

G = 2 to 4mm

*Normally used when R_F > 6.4mm

B-U2a

M3-2



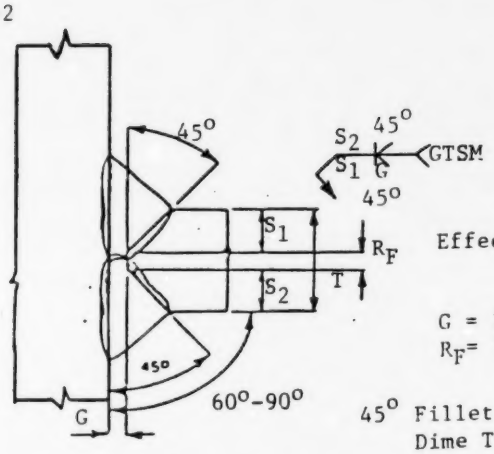
Effective Throat = T

G = 2 to 4mm

R_F = 1 to 2mm

B-U3b - (X)

M5-2



Effective Throat = T

G = 2 to 4mm

R_F= 1 to 2mm

45° Fillet Reinforcement Dime Test Requirement

TC-U5a - (X)

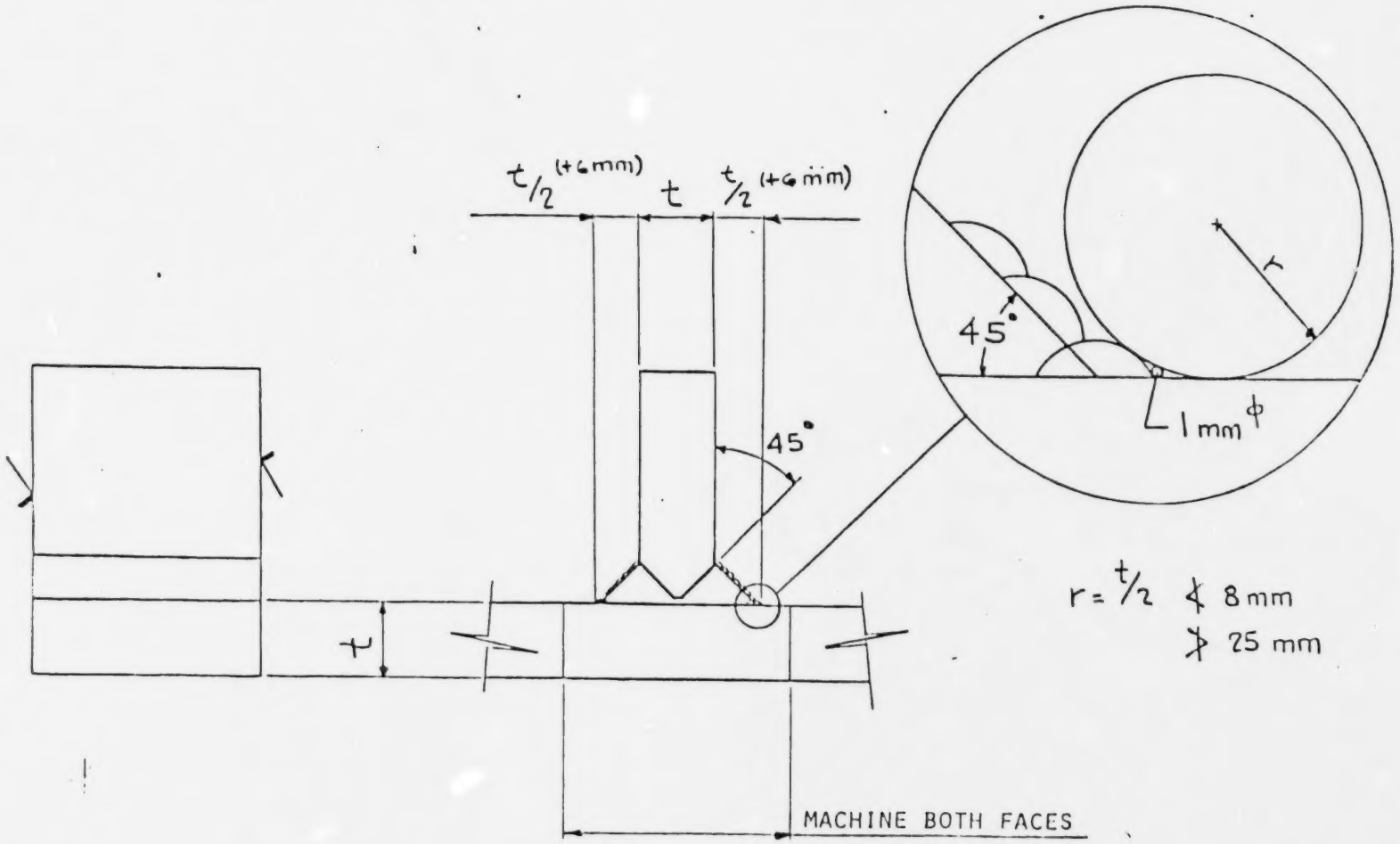


FIGURE 1 TYPICAL TEE BUTT WELD PREPARATION AND PROFILE

APPENDIX B

QC AND WELDING DATA SHEETS FOR 20 AND 40MM BUTT JOINTS

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 1

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 1

PLATE IDENTIFICATION NO.: 1

ELECTRODE TYPE: ESAB OK 48.08 (E7018-G)

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	[signature]
BACKGOUGE CHECK	(YES)	NO	[signature]
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	[signature]

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: 20/4/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 23-4-84

QA INSPECTOR'S SIGNATURE: [signature] DATE: 23/4/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 2

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 2

PLATE IDENTIFICATION NO.: 2

ELECTRODE TYPE: ESAB OK 48.68 (E7018-1)

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Denny Derry DATE: 25/4/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 27-4-84

QA INSPECTOR'S SIGNATURE: [signature] DATE: 27/4/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11 PROJECT NO: BN 18

SERIES NO: 3

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 3 PLATE IDENTIFICATION NO.: 3

ELECTRODE TYPE: ESAB OK 53.68 (E7016) PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2 PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 ÷ 130 POLARITY: DC+

VOLTAGE: 19 PREHEAT: RT °C

TRAVEL SPEED(mm/min): INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 ÷ 70 POST WELD HEAT: NA °C

HEAT INPUT 2 ÷ 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	
BACKGOUGE CHECK	(YES)	NO	
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: 24/4/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 27-4-84

QA INSPECTOR'S SIGNATURE: [signature] DATE: 27/4/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 4

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 4

PLATE IDENTIFICATION NO.: 4

ELECTRODE TYPE: ESAB OK 73.68 (E8018-C1)

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	[signature]
BACKGOUGE CHECK	(YES)	NO	[signature]
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	[signature]

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: 27/4/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 30-4-84

QA INSPECTOR'S SIGNATURE: [signature] DATE: 30/4/84

DATE: 29 AUGUST, 1984

DSS CONTRACT NO: 2-184-040-099
PROJECT NO: BN 18
SERIES NO: 5

WELDING DATA SHEET

POWER SOURCE:	LINCOLN R3R		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	5	PLATE IDENTIFICATION NO.:	5
ELECTRODE TYPE:	CLA LA 18 PLUS E7018-1	PLATE TYPE:	350 WT
ELECTRODE DIAMETER(mm):	3.2	PLATE THICKNESS(mm):	20

WELDING PARAMETERS

CURRENT:	110 → 130	POLARITY:	DC+
VOLTAGE:	19	PREHEAT:	RT °C
TRAVEL SPEED(mm/min):		INTERPASS HEAT:	230 °C
RUN OUT LENGTH(mm)	50 → 70	POST WELD HEAT:	NA °C
HEAT INPUT	2 → 2.6 kJ/mm		

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Dery DATE: 4/4/84

WELDING SUPERVISOR'S SIGNATURE: L Barfield DATE: 5/4/84

QC INSPECTOR'S SIGNATURE: G Proulx DATE: 5/4/84

DATE: 29 AUGUST, 1984

DSS CONTRACT NO: 2-184-040-099
PROJECT NO: 8N 18
SERIES NO: 6

WELDING DATA SHEET

POWER SOURCE:	LINCOLN R3R		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	6	PLATE IDENTIFICATION NO.:	6
ELECTRODE TYPE:	CLA AA 8018-C1	PLATE TYPE:	350 WT
ELECTRODE DIAMETER(mm):	3.2	PLATE THICKNESS(mm):	20

WELDING PARAMETERS

CURRENT:	110 → 130	POLARITY:	DC+
VOLTAGE:	19	PREHEAT:	RT °C
TRAVEL SPEED(mm/min):		INTERPASS HEAT:	230 °C
RUN OUT LENGTH(mm)	50 → 70	POST WELD HEAT:	NA °C
HEAT INPUT	2 → 2.6 kJ/mm		

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Deng DATE: 6/4/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 9/4/84

QC INSPECTOR'S SIGNATURE: G Prowse DATE: 9/4/84

DATE: 29 AUGUST, 1984

DSS CONTRACT NO: 2-184-040-099
PROJECT NO: BN 18
SERIES NO: 7

WELDING DATA SHEET

POWER SOURCE:	LINCOLN R3R		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	7	PLATE IDENTIFICATION NO.:	7
ELECTRODE TYPE:	CLA ATOMARC 8018 E8018-C3	PLATE TYPE:	350 WT
ELECTRODE DIAMETER(mm):	3.2	PLATE THICKNESS(mm):	20

WELDING PARAMETERS

CURRENT:	110 → 130	POLARITY:	DC+
VOLTAGE:	19	PREHEAT:	RT °C
TRAVEL SPEED(mm/min):		INTERPASS HEAT:	230 °C
RUN OUT LENGTH(mm)	50 → 70	POST WELD HEAT:	NA °C
HEAT INPUT	2 → 2.6 kJ/mm		

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO
STAMP "B" FOR PLATE BOTTOM		

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	
BACKGOUGE CHECK	(YES)	NO	
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4,5	3.2
5	6,7	3.2

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: 10/4/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 11/4/84

QC INSPECTOR'S SIGNATURE: [signature] DATE: 12/4/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 8

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 8

PLATE IDENTIFICATION NO.: 8

ELECTRODE TYPE: HOBART LMP E7018

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: 3/5/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 1-6-84

QA INSPECTOR'S SIGNATURE: [signature] DATE: 4/6/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 9

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 9

PLATE IDENTIFICATION NO.: 9

ELECTRODE TYPE: MUREX FORTREX E8018-C2

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Deus DATE: 4/6/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 5-6-84

QA INSPECTOR'S SIGNATURE: [signature] DATE: 5/6/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 10

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 10

PLATE IDENTIFICATION NO.: 10

ELECTRODE TYPE: HOBART E8018-C1

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	DP
BACKGOUGE CHECK	(YES)	NO	DP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	DP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Denny Derry DATE: 25/5/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 28-5-84

QA INSPECTOR'S SIGNATURE: [signature] DATE: 29/5/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 11

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 11

PLATE IDENTIFICATION NO.: 11

ELECTRODE TYPE: HOBART E8018-C2

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	DP
BACKGOUGE CHECK	(YES)	NO	DP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	DP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Deus DATE: 28/5/84

WELDING SUPERVISOR'S SIGNATURE: S Banfield DATE: 30-5-84

QA INSPECTOR'S SIGNATURE: D Pond DATE: 31/5/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 12

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 12

PLATE IDENTIFICATION NO.: 12

ELECTRODE TYPE: HOBART E8018-C3

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Dew DATE: 29/5/84

WELDING SUPERVISOR'S SIGNATURE: S Banfield DATE: 30-5-84

QA INSPECTOR'S SIGNATURE: JP Howe DATE: 31/5/84

DATE: 29 AUGUST, 1984

DSS CONTRACT NO: 2-184-040-099
PROJECT NO: BN 18
SERIES NO: 13

WELDING DATA SHEET

POWER SOURCE:	LINCOLN R3R		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	13	PLATE IDENTIFICATION NO.:	13
ELECTRODE TYPE:	LINCOLN JET LH 75	PLATE TYPE:	350 WT
ELECTRODE DIAMETER(mm):	3.2	PLATE THICKNESS(mm):	20

WELDING PARAMETERS

CURRENT:	110 → 130	POLARITY:	DC+
VOLTAGE:	19	PREHEAT:	RT °C
TRAVEL SPEED(mm/min):		INTERPASS HEAT:	230 °C
RUN OUT LENGTH(mm)	50 → 70	POST WELD HEAT:	NA °C
HEAT INPUT	2 → 2.6 kJ/mm		

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Denny DATE: 11/4/84

WELDING SUPERVISOR'S SIGNATURE: S Bonfield DATE: 12/4/84

QC INSPECTOR'S SIGNATURE: GP Inspector DATE: 12/4/84

DATE: 29 AUGUST, 1984

DSS CONTRACT NO: 2-184-040-099
PROJECT NO: BN 18
SERIES NO: 14

WELDING DATA SHEET

POWER SOURCE:	LINCOLN R3R		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	14	PLATE IDENTIFICATION NO.:	14
ELECTRODE TYPE:	LINCOLN JET LH78	PLATE TYPE:	350 WT
ELECTRODE DIAMETER(mm):	3.2	PLATE THICKNESS(mm):	20

WELDING PARAMETERS

CURRENT:	110 → 130	POLARITY:	DC+
VOLTAGE:	19	PREHEAT:	RT °C
TRAVEL SPEED(mm/min):		INTERPASS HEAT:	230 °C
RUN OUT LENGTH(mm)	50 → 70	POST WELD HEAT:	NA °C
HEAT INPUT	2 → 2.6 kJ/mm		

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Denny DATE: 13/4/84

WELDING SUPERVISOR'S SIGNATURE: S Benfield DATE: 16/4/84

QC INSPECTOR'S SIGNATURE: D Proulx DATE: 16/4/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 15

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 15

PLATE IDENTIFICATION NO.: 15

ELECTRODE TYPE: LINCOLN JET LH8018-C1

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Denni Deus DATE: 18/4/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 19-4-84

QA INSPECTOR'S SIGNATURE: GP [signature] DATE: 19/4/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 16

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 16

PLATE IDENTIFICATION NO.: 16

ELECTRODE TYPE: LINCOLN JET LH8018-C3

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	DP
BACKGOUGE CHECK	(YES)	NO	DP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	DP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Dew DATE: 12/4/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 12-4-84

QA INSPECTOR'S SIGNATURE: DP [signature] DATE: 12/4/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 17

QC & WELDING DATA SHEET

POWER SOURCE:	LINCOLN R3R		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	17	PLATE IDENTIFICATION NO.:	17
ELECTRODE TYPE:	MUREX E7016 C1L	PLATE TYPE:	350 WT
ELECTRODE DIAMETER(mm):	3.2	PLATE THICKNESS(mm):	20

WELDING PARAMETERS

CURRENT:	110 ÷ 130	POLARITY:	DC+
VOLTAGE:	19	PREHEAT:	RT °C
TRAVEL SPEED(mm/min):		INTERPASS HEAT:	230 °C
RUN OUT LENGTH(mm)	50 ÷ 70	POST WELD HEAT:	NA °C
HEAT INPUT	2 ÷ 2.6 kJ/mm		

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO
STAMP "B" FOR PLATE BOTTOM		

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Deen DATE: 23/5/84

WELDING SUPERVISOR'S SIGNATURE: R Banfield DATE: 28-5-84

QA INSPECTOR'S SIGNATURE: GP Proulx DATE: 28/5/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11 PROJECT NO: BN 18

SERIES NO: 18

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 18 PLATE IDENTIFICATION NO.: 18

ELECTRODE TYPE: MUREX FEREX STF (E7016) PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2 PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130 POLARITY: DC+

VOLTAGE: 19 PREHEAT: RT °C

TRAVEL SPEED(mm/min): INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70 POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	
BACKGOUGE CHECK	(YES)	NO	
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: DATE: 24/5/84

WELDING SUPERVISOR'S SIGNATURE: DATE: 28-5-84

QA INSPECTOR'S SIGNATURE: DATE: 28/5/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11 PROJECT NO: BN 18

SERIES NO: 19

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 19 PLATE IDENTIFICATION NO.: 19

ELECTRODE TYPE: OERLIKON TENACO 60 (E8018G) PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2 PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130 POLARITY: DC+

VOLTAGE: 19 PREHEAT: RT °C

TRAVEL SPEED(mm/min): INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70 POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	DP
BACKGOUGE CHECK	(YES)	NO	DP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	DP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Derry DATE: 6/6/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 6-6-84

QA INSPECTOR'S SIGNATURE: DP [illegible] DATE: 6/6/84

DSS CONTRACT NO: 2-184-040-099

DATE: 1984-06-11

PROJECT NO: BN 18

SERIES NO: 20

QC & WELDING DATA SHEET

POWER SOURCE: LINCOLN R3R

WELDING PROCESS: SMAW

WELDING POSITION: 3G

ELECTRODE IDENTIFICATION NO.: 20

PLATE IDENTIFICATION NO.: 20

ELECTRODE TYPE: OERLIKON E7018-1

PLATE TYPE: 350 WT

ELECTRODE DIAMETER(mm): 3.2

PLATE THICKNESS(mm): 20

WELDING PARAMETERS

CURRENT: 110 → 130

POLARITY: DC+

VOLTAGE: 19

PREHEAT: RT °C

TRAVEL SPEED(mm/min):

INTERPASS HEAT: 230 °C

RUN OUT LENGTH(mm) 50 → 70

POST WELD HEAT: NA °C

HEAT INPUT 2 → 2.6 kJ/mm

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL (YES) NO

USE OF RESTRAINTS (YES) NO

STAMP "B" FOR PLATE BOTTOM

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
DIME TEST	YES	(NO)	
FINAL INSPECTION	(YES)	NO	GP

JOINT GEOMETRY

- As Attached Joint M2-1

LAYER NO.	PASS NO.	ELECTRODE DIAMETER
1	1	3.2
2	2	3.2
3	3	3.2
4	4	3.2
5	5,6	3.2

WELDING TECHNICIAN'S SIGNATURE: Dennis Deering DATE: 6/6/84

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: 6-6-84

QA INSPECTOR'S SIGNATURE: GP [illegible] DATE: 6/6/84

DSS CONTRACT NO: 15SQ-23440-3-9016
PROJECT NO. 2-154-040-099
SERIES NO: 21A

WELDING DATA AND QC SHEET

POWER SOURCE:	Lincoln TM 400/400		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	TE	PLATE IDENTIFICATION NO.:	21A
ELECTRODE TYPE:	CLA CA 18 Plus	PLATE TYPE:	G40.21-350 WT
ELECTRODE DIAMETER(mm):	3.2 & 4.0	PLATE THICKNESS(mm):	40

WELDING PARAMETERS

CURRENT:	120/160	POLARITY:	DC+
VOLTAGE:	21	PREHEAT:	100°C (212°F)
TRAVEL SPEED(mm/min):	78/100	INTERPASS HEAT:	250°C (480°F)
HEAT INPUT	2	SHIELDING GAS:	N/A
		FLOW RATE:	N/A

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
FINAL INSPECTION	(YES)	NO	GP
POST WELD HEAT TREATMENT 590°C (110°F) FOR 2 HOURS	YES	(NO)	

JOINT GEOMETRY

LAYER NO.	PASS NO.	ELECTRODE DIAMETER

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: 6 5 05

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE:

QC INSPECTOR'S SIGNATURE: GP [signature] DATE: 6/5/05

DSS CONTRACT NO: 1550-23440-3-9218
PROJECT NO. 2-184-040-099
SERIES NO: 21B

WELDING DATA AND QC SHEET

POWER SOURCE:	Lincoln TM 400/400		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	TE	PLATE IDENTIFICATION NO.:	21B
ELECTRODE TYPE:	CLA CA 18 Plus	PLATE TYPE:	G40.21-350 WT
ELECTRODE DIAMETER(mm):	3.2 & 4.0	PLATE THICKNESS(mm):	40

WELDING PARAMETERS

CURRENT:	120/160	POLARITY:	DC+
VOLTAGE:	21	PREHEAT:	100°C (212°F)
TRAVEL SPEED(mm/min):	78/100	INTERPASS HEAT:	250°C (480°F)
HEAT INPUT	2	SHIELDING GAS:	N/A
		FLOW RATE:	N/A

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
FINAL INSPECTION	(YES)	NO	GP
POST WELD HEAT TREATMENT 590°C (110°F) FOR 2 HOURS	(YES)	NO	GP

JOINT GEOMETRY

LAYER NO.	PASS NO.	ELECTRODE DIAMETER

WELDING TECHNICIAN'S SIGNATURE: _____ DATE: _____

WELDING SUPERVISOR'S SIGNATURE: _____ DATE: _____

QC INSPECTOR'S SIGNATURE: GPrud'ho DATE: 6/5/05

DSS CONTRACT NO: 15SC-23440-3-9218
PROJECT NO. 2-164-040-099
SERIES NO: 22A

WELDING DATA AND QC SHEET

POWER SOURCE:	Lincoln TM 400/400		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	TE	PLATE IDENTIFICATION NO.:	22A
ELECTRODE TYPE:	CLA E8018-C1	PLATE TYPE:	G40.21-350 WT
ELECTRODE DIAMETER(mm):	3.2 & 4.0	PLATE THICKNESS(mm):	40

WELDING PARAMETERS

CURRENT:	120/160	POLARITY:	DC+
VOLTAGE:	21	PREHEAT:	100°C (212°F)
TRAVEL SPEED(mm/min):	78/100	INTERPASS HEAT:	250°C (480°F)
HEAT INPUT	2	SHIELDING GAS:	N/A
		FLOW RATE:	N/A

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
FINAL INSPECTION	(YES)	NO	GP
POST WELD HEAT TREATMENT 590°C (110°F) FOR 2 HOURS	YES	(NO)	

JOINT GEOMETRY

LAYER NO.	PASS NO.	ELECTRODE DIAMETER

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: [illegible]

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: [illegible]

QC INSPECTOR'S SIGNATURE: GPioud DATE: 6/5/85

DSS CONTRACT NO: 1SSO-23440-3-9219
PROJECT NO. 2-164-040-099
SERIES NO: 22B

WELDING DATA AND QC SHEET

POWER SOURCE:	Lincoln TM 400/400		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	TE	PLATE IDENTIFICATION NO.:	22B
ELECTRODE TYPE:	CLA E8018-C1	PLATE TYPE:	G40.21-350 WT
ELECTRODE DIAMETER(mm):	3.2 & 4.0	PLATE THICKNESS(mm):	40

WELDING PARAMETERS

CURRENT:	120/160	POLARITY:	DC+
VOLTAGE:	21	PREHEAT:	100°C (212°F)
TRAVEL SPEED(mm/min):	78/100	INTERPASS HEAT:	250°C (480°F)
HEAT INPUT	2	SHIELDING GAS:	N/A
		FLOW RATE:	N/A

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
FINAL INSPECTION	(YES)	NO	GP
POST WELD HEAT TREATMENT 590°C (110°F) FOR 2 HOURS	(YES)	NO	GP

JOINT GEOMETRY

LAYER NO.	PASS NO.	ELECTRODE DIAMETER

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: [illegible]

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: [illegible]

QC INSPECTOR'S SIGNATURE: [signature] DATE: 6/5/85

DSS CONTRACT NO: 15SQ-23440-3-9216
PROJECT NO. 2-164-040-099
SERIES NO: 23A

WELDING DATA AND QC SHEET

POWER SOURCE:	Lincoln TM 400/400		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	TE	PLATE IDENTIFICATION NO.:	23A
ELECTRODE TYPE:	MUREX STF	PLATE TYPE:	G40.21-350 WT
ELECTRODE DIAMETER(mm):	3.2 & 4.0	PLATE THICKNESS(mm):	40

WELDING PARAMETERS

CURRENT:	120/160	POLARITY:	AC
VOLTAGE:	21	PREHEAT:	100°C (212°F)
TRAVEL SPEED(mm/min):	78/100	INTERPASS HEAT:	250°C (480°F)
HEAT INPUT	2	SHIELDING GAS:	N/A
		FLOW RATE:	N/A

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
FINAL INSPECTION	(YES)	NO	GP
POST WELD HEAT TREATMENT 590°C (110°F) FOR 2 HOURS	YES	(NO)	

JOINT GEOMETRY

LAYER NO.	PASS NO.	ELECTRODE DIAMETER

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: [illegible]

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE:

QC INSPECTOR'S SIGNATURE: [signature] DATE: 6/5/85

DSS CONTRACT NO: 15SQ-23440-3-9218
PROJECT NO. 2-184-040-099
SERIES NO: 23B

WELDING DATA AND QC SHEET

POWER SOURCE:	Lincoln TM 400/400		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	TE	PLATE IDENTIFICATION NO.:	23B
ELECTRODE TYPE:	MUREX STF	PLATE TYPE:	G40.21-350 WT
ELECTRODE DIAMETER(mm):	3.2 & 4.0	PLATE THICKNESS(mm):	40

WELDING PARAMETERS

CURRENT:	120/160	POLARITY:	AC
VOLTAGE:	21	PREHEAT:	100°C (212°F)
TRAVEL SPEED(mm/min):	78/100	INTERPASS HEAT:	250°C (480°F)
HEAT INPUT	2	SHIELDING GAS:	N/A
		FLOW RATE:	N/A

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
FINAL INSPECTION	(YES)	NO	GP
POST WELD HEAT TREATMENT 590°C (110°F) FOR 2 HOURS	(YES)	NO	GP

JOINT GEOMETRY

LAYER NO.	PASS NO.	ELECTRODE DIAMETER

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: 6/5/85

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE:

QC INSPECTOR'S SIGNATURE: G Phelps DATE: 6/5/85

DSS CONTRACT NO: 1SSC-23440-3-9218
PROJECT NO. 2-184-040-099
SERIES NO: 24A

WELDING DATA AND QC SHEET

POWER SOURCE:	Lincoln TM 400/400		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	TE	PLATE IDENTIFICATION NO.:	24A
ELECTRODE TYPE:	ESAB OK 73.68	PLATE TYPE:	G40.21-350 WT
ELECTRODE DIAMETER(mm):	3.2 & 4.0	PLATE THICKNESS(mm):	40

WELDING PARAMETERS

CURRENT:	120/160	POLARITY:	DC+
VOLTAGE:	21	PREHEAT:	100°C (212°F)
TRAVEL SPEED(mm/min):	78/100	INTERPASS HEAT:	250°C (480°F)
HEAT INPUT	2	SHIELDING GAS:	N/A
		FLOW RATE:	N/A

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
FINAL INSPECTION	(YES)	NO	GP
POST WELD HEAT TREATMENT 590°C (110°F) FOR 2 HOURS	YES	(NO)	

JOINT GEOMETRY

LAYER NO.	PASS NO.	ELECTRODE DIAMETER

WELDING TECHNICIAN'S SIGNATURE: [signature] DATE: 5-6-85

WELDING SUPERVISOR'S SIGNATURE: [signature] DATE: _____

QC INSPECTOR'S SIGNATURE: [signature] DATE: 6/5/85

DSS CONTRACT NO: 15SQ-23440-3-9218
PROJECT NO. 2-184-040-099
SERIES NO: 24B

WELDING DATA AND QC SHEET

POWER SOURCE:	Lincoln TM 400/400		
WELDING PROCESS:	SMAW	WELDING POSITION:	3G
ELECTRODE IDENTIFICATION NO.:	TE	PLATE IDENTIFICATION NO.:	24B
ELECTRODE TYPE:	ESAB OK 73.68	PLATE TYPE:	G40.21-350 WT
ELECTRODE DIAMETER(mm):	3.2 & 4.0	PLATE THICKNESS(mm):	40

WELDING PARAMETERS

CURRENT:	120/160	POLARITY:	DC+
VOLTAGE:	21	PREHEAT:	100°C (212°F)
TRAVEL SPEED(mm/min):	78/100	INTERPASS HEAT:	250°C (480°F)
HEAT INPUT	2	SHIELDING GAS:	N/A
		FLOW RATE:	N/A

ADDITIONAL INFORMATION

BACKGOUGE TO SOUND METAL	(YES)	NO
USE OF RESTRAINTS	(YES)	NO

QUALITY CONTROL HOLD POINTS

			SIGNATURE
FIT-UP PRIOR TO WELDING	(YES)	NO	GP
BACKGOUGE CHECK	(YES)	NO	GP
FINAL INSPECTION	(YES)	NO	GP
POST WELD HEAT TREATMENT 590°C (110°F) FOR 2 HOURS	(YES)	NO	GP

JOINT GEOMETRY

LAYER NO.	PASS NO.	ELECTRODE DIAMETER

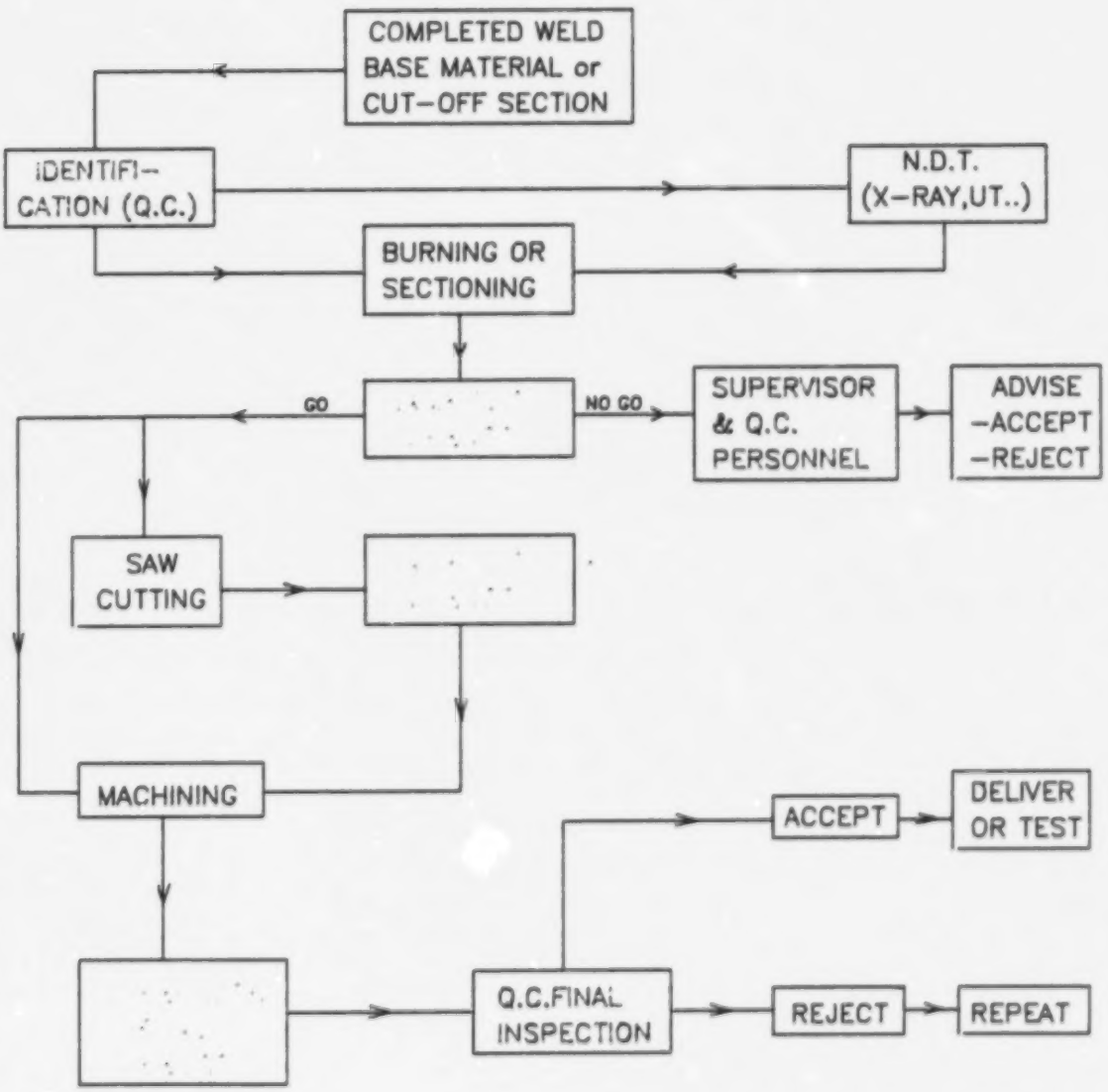
WELDING TECHNICIAN'S SIGNATURE: _____ DATE: _____

WELDING SUPERVISOR'S SIGNATURE: _____ DATE: _____

QC INSPECTOR'S SIGNATURE: G Prowse DATE: 6/5/05

APPENDIX C
SAMPLE SPECIFICATIONS

QUALITY CONTROL FLOW CHART



AMCA INTERNATIONAL

Contract: _____

Customer: _____

QUALITY CONTROL DOCUMENT

All precision measuring tools are subject to a periodical in-house calibration system. The calibration procedure is included in Appendix A, along with a sample calibration copy. The respective test samples have specific dimensions, tolerances, contour or shape restrictions and surface finish as stated in the appropriate codes. The surface finish of a sample is a product of tool condition, feeds, speeds, and coolant. A number of important factors are listed as follows:

Tensiles:
- Location of tensile
- Type
- Overall length
- Gauge length
- Corner radius
- Diameter or dimensions of cross section
- Squareness of reduced section
- Surface finish

CVN:
- Location of sample within cross section
- Squareness
- Overall length
- Slot location and orientation
- Slot configuration
- Surface finish
- Slot depth
- Cross section dimensions

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AMCA INTERNATIONAL

CTOD:
- Location of sample within cross section
- Squareness
- Overall length
- Slot location and orientation
- Slot depth
- Slot configuration
- Surface finish
- Cross section dimensions

Drop Weight:
- Cross section dimensions
- Overall length
- Location and orientation of slot
- Slot depth
- Slot configuration

Fatigue:
- Overall dimensions (length, width, thickness)
- Corner radius
- Squareness or diameter

The flow chart is a simplified version of the sequence used for flame cutting, sawing, machining and inspection stages. Since there are a number of different codes, sample sizes and/or configurations, the chart and QC document is generalized as follows:

(1) On receipt of the material to be tested, a series of requests are issued to provide specific instructions for each stage of fabrication.

(2) The first request will provide the proper identification scheme which is then verified by quality control personnel.

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(3) On that same request, further instructions will be provided for:
   (a) Non-destructive testing (which specific test)
   (b) Refer to a burning, sectioning of cutting diagram or attach a specific diagram detailing all required sections.

(4) Upon completion of all sectioning, the samples are placed in a designated area awaiting inspection by the machinist. If the samples are prepared in accordance with the request, the machinist will accept them. If they do not meet the requirements, the supervisor and QC personnel will be informed and a decision made after consultation to advise the customer, accept or reject the samples.

(5) When the machining is complete, the supervisor has to inspect the test specimens. Once the inspection is complete, the samples go to the QC final inspection along with all documents containing inspection signatures and documented discrepancies.

(6) The QC personnel will inspect all samples and documents before accepting or rejecting the test samples.

MACHINE SHOP QC DOCUMENT

Test Type: Tensile ☐

CVN ☐

CTOD ☐

Drop Weight ☐

Fatigue ☐

Other ☐ Type _____

Reference Drawing No.: _____

Nugget Size: Length _____ Width _____

Height _____ Diameter _____

Final Actual Dimensions: Length _____ Width _____

Height _____ Diameter _____

Gauge Length _____

Crack Depth _____

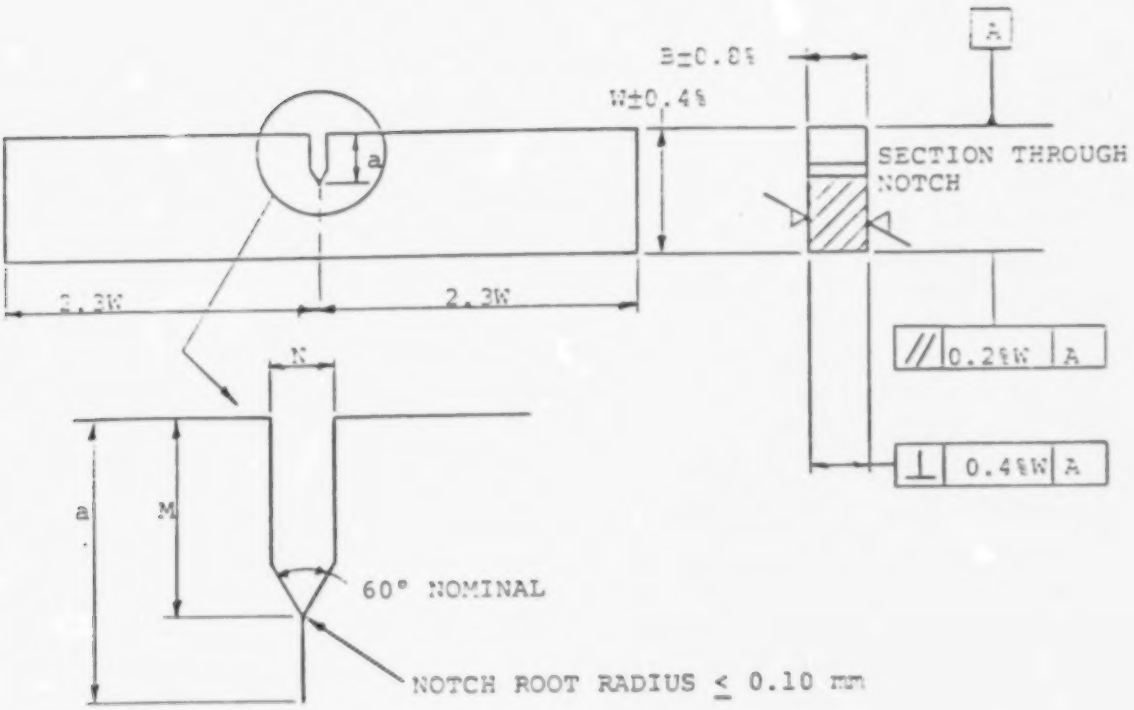
Other

Machinist's Signature _____ Date: _____

Supervisor's Signature _____ Date: _____

QA Signature _____ Date: _____

CRACK TIP OPENING DISPLACEMENT (CTOD)



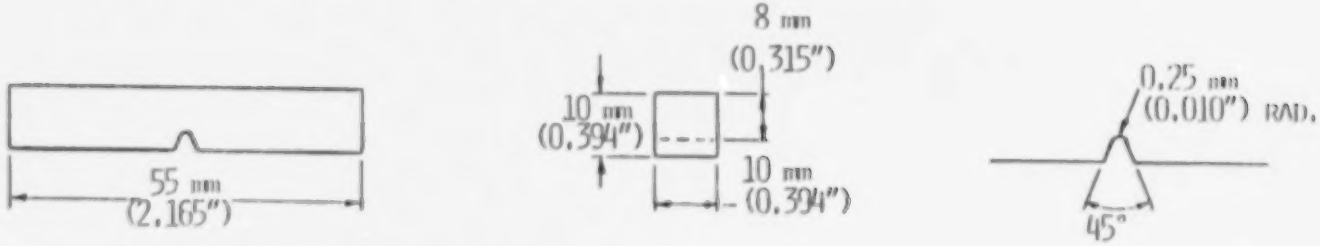
Width	= W
Thickness	= B = 0.5 W
Half Loading Span L	= 2 W
Notch Width N	= 0.065 W max. (if W is over 25 mm) or = 1.5 mm max. (if W ≤ 25 mm)
Effective Notch Length M	= 0.25 W to 0.45 W
Effective Crack Length A	= 0.45 W to 0.55 W

Note 1: Sawn notches may also be used.

Note 2: Where one (or more) of the specimen surfaces is the original product, surface machining of that surface is not required.

All dimensions are in millimetres.

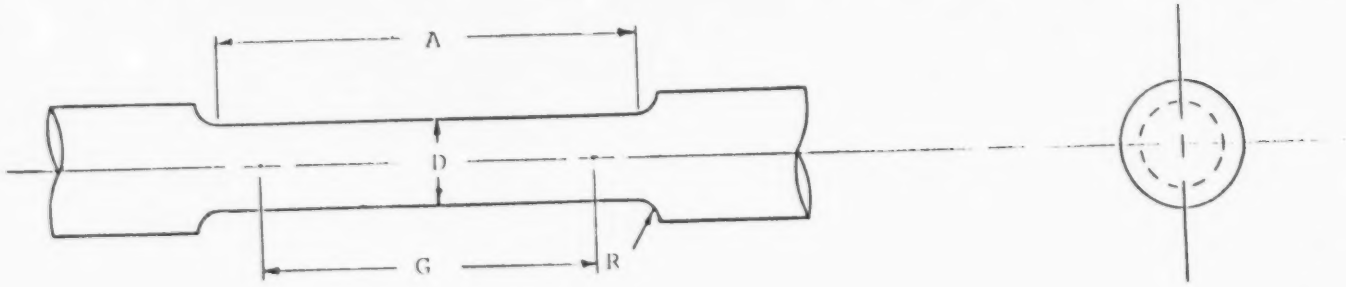
Simple Beam Impact Test Specimen



NOTE - Permissible variations shall be as follows:

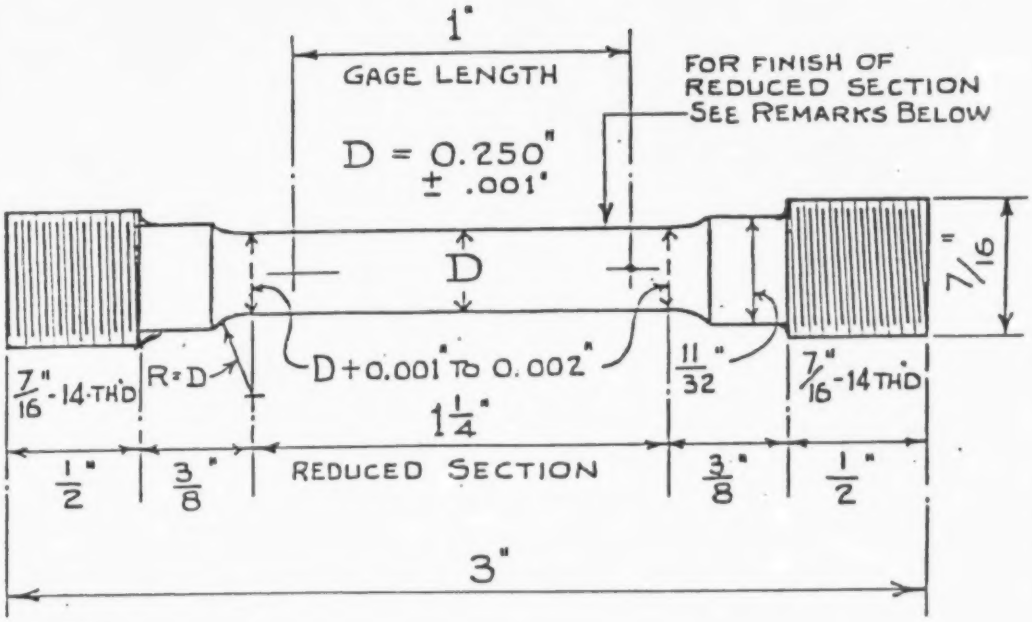
Adjacent sides shall be at	90 deg. ± 10 min
Cross section dimensions	± 0.025 mm (0.001 in.)
Length of specimen	± 0, -2.5 mm (0.100 in.)
Angle of notch	± 1 deg.
Radius of notch	± 0.025 mm (0.001 in.)
Dimensions to bottom of notch:	
Specimen Type A	8 ± 0.025 mm (0.315 ± 0.001 in.)

STANDARD 0.500 in. (12.5 mm) ROUND TENSION TEST SPECIMEN WITH 2 in. (50 mm) GAGE LENGTH AND EXAMPLES OF SMALL-SIZE SPECIMENS PROPORTIONAL TO THE STANDARD SPECIMEN.



DIMENSIONS

NOMINAL DIAMETER	STANDARD SPECIMEN		SMALL-SIZE SPECIMENS PORPORTIONAL TO STANDARD							
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
	0.500	12.5	0.350	8.75	0.250	6.25	0.160	4.00	0.113	2.50
G - GAGE LENGTH	2.000± 0.005	50.0± 0.10	1.400± 0.005	35.0± 0.10	1.000± 0.005	25.0± 0.10	0.640± 0.005	16.0± 0.10	0.450± 0.005	10.0± 0.10
D - DIAMETER (NOTE 1)	0.500± 0.010	12.5± 0.25	0.350± 0.007	8.75± 0.18	0.250± 0.005	6.25± 0.12	0.160± 0.003	4.00± 0.08	0.113± 0.002	2.50± 0.05
R - RADIUS OF FILLET, MIN	3/8	10	1/4	6	3/16	5	5/32	4	3/32	2
A - LENGTH OF REDUCED SECTION, MIN (NOTE 2)	2 1/4	60	1 3/4	45	1 1/4	32	3/4	20	5/8	16



NOTE

THE DIAMETER MUST NOT VARY MORE THAN .001" ALONG THE GAGE LENGTH.

NOT TO SCALE

1/4" TENSILE SAMPLE

REMARKS

FINISH REQUIRED ON REDUCED SECTION TO BE AS SPECIFIED ON WORK ORDER IF NOT SPECIFIED FINISH IS TO BE ▽

▽ – ORDINARY MACHINE FINISH
▽ ▽ – GOOD MACHINE FINISH
▽ ▽ ▽ – VERY GOOD MACHINE FINISH

FIGURE 1

APPENDIX D
HYDROGEN DIFFUSION RELEASE DOCUMENTS

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 1

Temperature (C): 93

Time In (Hr. and Date): 4pm 7-5-84

Time Out (Hr. and Date): 4PM 9-5-84

Supervisor's Signature: S Bonfield

Q.C. Signature: D. Powers

TENSILE

I.D. No.: 1

Temperature (C): 93

Time In (Hr. and Date): 4PM 7-5-84

Time Out (Hr. and Date): 4PM 9-5-84

Supervisor's Signature: S Bonfield

Q.C. Signature: D. Powers

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 2.

Temperature (C): 93

Time In (Hr. and Date): 4 PM 7-5-84

Time Out (Hr. and Date): 4-PM 9·5·84

Supervisor's Signature: S Banfield

Q.C. Signature: D Pauly

TENSILE

I.D. No.: 2.

Temperature (C): 93

Time In (Hr. and Date): 4PM 7-5·84

Time Out (Hr. and Date): 4PM 9-5·84

Supervisor's Signature: S Banfield

Q.C. Signature: D Pauly

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 3

Temperature (C): 93

Time In (Hr. and Date): 4 PM 7-5-84

Time Out (Hr. and Date): 4 PM 9-5-84

Supervisor's Signature: S Banfield

Q.C. Signature: J Prouty

TENSILE

I.D. No.: 3

Temperature (C): 93

Time In (Hr. and Date): 4 PM 7-5-84

Time Out (Hr. and Date): 4 PM 9-5-84

Supervisor's Signature: S Banfield

Q.C. Signature: J Prouty

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 4

Temperature (C): 93

Time In (Hr. and Date): 4PM 7-5-84

Time Out (Hr. and Date): 4PM 9-5-84

Supervisor's Signature: S Bonfield

Q.C. Signature: J Prowse

TENSILE

I.D. No.: 4

Temperature (C): 93

Time In (Hr. and Date): 4PM 7-5-84

Time Out (Hr. and Date): 4PM 9-5-84

Supervisor's Signature: S Bonfield

Q.C. Signature: J Prowse

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 5

Temperature (C): 93

Time In (Hr. and Date): 1330 24-4-84

Time Out (Hr. and Date): 1330 26-4-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proud

TENSILE

I.D. No.: 5

Temperature (C): 93

Time In (Hr. and Date): 1330 24-4-84

Time Out (Hr. and Date): 1330 26-4-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proud

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 6

Temperature (C): 93

Time In (Hr. and Date): 1 30 24-4-84

Time Out (Hr. and Date): 1 30 26-4-84

Supervisor's Signature: S Donfield

Q.C. Signature: G Prowse

TENSILE

I.D. No.: 6

Temperature (C): 93

Time In (Hr. and Date): 1 30 PM 24-4-84

Time Out (Hr. and Date): 1 30 PM 26-4-84

Supervisor's Signature: S Donfield

Q.C. Signature: G Prowse

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 7

Temperature (C): 93

Time In (Hr. and Date): 1[30] 24-4-84

Time Out (Hr. and Date): 1[30] 26-4-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proud

TENSILE

I.D. No.: 7

Temperature (C): 93

Time In (Hr. and Date): 1[30] 24-4-84

Time Out (Hr. and Date): 1[30] 26-4-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proud

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 8

Temperature (C): 93

Time In (Hr. and Date): 9^30 21-6-84

Time Out (Hr. and Date): 9^30 23-6-84.

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proud

TENSILE

I.D. No.: 8

Temperature (C): 93.

Time In (Hr. and Date): 9^30 21-6-84.

Time Out (Hr. and Date): 9^30 23-6-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proud

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 9

Temperature (C): 93

Time In (Hr. and Date): 4^{10} 18-6-84

Time Out (Hr. and Date): 4^{10} 20·6·84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proud

TENSILE

I.D. No.: 9

Temperature (C): 93

Time In (Hr. and Date): 4^{10} 18-6-84

Time Out (Hr. and Date): 4^{10} 20-6-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proud

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 10

Temperature (C): 93

Time In (Hr. and Date): 4^15 18-6-84

Time Out (Hr. and Date): 4^10 20-6-84

Supervisor's Signature: [signature]

Q.C. Signature: [signature]

TENSILE

I.D. No.: 10

Temperature (C): 93

Time In (Hr. and Date): 4^10 18-6-84

Time Out (Hr. and Date): 4^15 20-6-84.

Supervisor's Signature: [signature]

Q.C. Signature: [signature]

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 11

Temperature (C): 93

Time In (Hr. and Date): 4^16 18-6-84

Time Out (Hr. and Date): 4^16 20-6-84

Supervisor's Signature: [signature]

Q.C. Signature: [signature]

TENSILE

I.D. No.: 11

Temperature (C): 93

Time In (Hr. and Date): 4^15 18-6-84

Time Out (Hr. and Date): 4^16 20-6-84

Supervisor's Signature: [signature]

Q.C. Signature: [signature]

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 12

Temperature (C): 93

Time In (Hr. and Date): 9^{30} 21-6-84

Time Out (Hr. and Date): 9^{30} 23-6-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Prouty

TENSILE

I.D. No.: 12

Temperature (C): 93

Time In (Hr. and Date): 9^{30} 21-6-84

Time Out (Hr. and Date): 9^{30} 23-6-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Prouty

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 13

Temperature (C): 93

Time In (Hr. and Date): 1[30] 24-4-84

Time Out (Hr. and Date): 1[30] 26-4-84

Supervisor's Signature: S Banfield

Q.C. Signature: G Prouty

TENSILE

I.D. No.: 13

Temperature (C): 93

Time In (Hr. and Date): 1[30] 24-4-84

Time Out (Hr. and Date): 1[30] 26-4-84

Supervisor's Signature: S Banfield

Q.C. Signature: G Prouty

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 14

Temperature (C): 93

Time In (Hr. and Date): 1 30 24-4-84

Time Out (Hr. and Date): 1 30 26-4-84

Supervisor's Signature: S Banfield

Q.C. Signature: G Prouty

TENSILE

I.D. No.: 14

Temperature (C): 93

Time In (Hr. and Date): 1 30 24-4-84

Time Out (Hr. and Date): 1 30 26-4-84

Supervisor's Signature: S Banfield

Q.C. Signature: G Prouty

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 15

Temperature (C): 93

Time In (Hr. and Date): 4 PM 7-5-84

Time Out (Hr. and Date): 4 PM 9.5.84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proulx

TENSILE

I.D. No.: 15

Temperature (C): 93

Time In (Hr. and Date): 4PM 7.5.84

Time Out (Hr. and Date): 4PM 9.5.84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proulx

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 16

Temperature (C): 93

Time In (Hr. and Date): 4PM 7-5-84

Time Out (Hr. and Date): 4PM 9-5 84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proulx

TENSILE

I.D. No.: 16

Temperature (C): 93

Time In (Hr. and Date): 4PM 7-5-84

Time Out (Hr. and Date): 4PM 9 5 84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proulx

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 17

Temperature (C): 93.

Time In (Hr. and Date): 4^15 18-6-84

Time Out (Hr. and Date): 4^15 20-6-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Prowse

TENSILE

I.D. No.: 17

Temperature (C): 93

Time In (Hr. and Date): 4^15 18-6-84

Time Out (Hr. and Date): 4^15 20-6-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Prowse

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 18

Temperature (C): 93

Time In (Hr. and Date): 4^15 18-6-84

Time Out (Hr. and Date): 4^15 20-6-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proud

TENSILE

I.D. No.: 18

Temperature (C): 93

Time In (Hr. and Date): 4^15 18-6-84

Time Out (Hr. and Date): 4^15 20-6-84

Supervisor's Signature: S Bonfield

Q.C. Signature: G Proud

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 19

Temperature (C): 93

Time In (Hr. and Date): 9^30 21-6-84

Time Out (Hr. and Date): 9^30 23-6-84

Supervisor's Signature: S Bonfield

Q.C. Signature: D Prowse

TENSILE

I.D. No.: 19

Temperature (C): 93

Time In (Hr. and Date): 9^30 21-6-84

Time Out (Hr. and Date): 9^30 23-6-84

Supervisor's Signature: S Bonfield

Q.C. Signature: D Prowse

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 20

Temperature (C): 93

Time In (Hr. and Date): 9^30 21-6-84

Time Out (Hr. and Date): 9^30 23-6-84

Supervisor's Signature: S. Bonfield

Q.C. Signature: G Prowse

TENSILE

I.D. No.: 20

Temperature (C): 93

Time In (Hr. and Date): 9^30 21-6-84

Time Out (Hr. and Date): 9^30 23-6-84

Supervisor's Signature: S. Bonfield

Q.C. Signature: G Prowse

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 21 A+B

Temperature (°C): 93

Time In (Hr. and Date): 9 AM 13-2-85

Time Out (Hr. and Date): 9 AM 15-2-85

Supervisor's Signature: S Bayo

Q.C. Signature: D Prouty

TENSILE

I.D. No.: 21 A+B

Temperature (°C): 93

Time In (Hr. and Date): 9 AM 13-2-85

Time Out (Hr. and Date): 9 AM 15-2-85

Supervisor's Signature: S. B.

Q.C. Signature: D Prouty

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 22 A+B

Temperature (°C): 93

Time In (Hr. and Date: 9 AM 13-2-85

Time Out (Hr. and Date): 9 AM 15-2-85

Supervisor's Signature: S. B

Q.C. Signature: J Proud

TENSILE

I.D. No.: 22 A+B

Temperature (°C): 93

Time In (Hr. and Date: 9AM 13-2-85

Time Out (Hr. and Date): 9AM 15-2-85

Supervisor's Signature: S-B

Q.C. Signature: J Proud

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 23 A+B

Temperature (°C): 93

Time In (Hr. and Date: 3PM 27-2-85

Time Out (Hr. and Date): 3PM 1-3-85

Supervisor's Signature: S. B

Q.C. Signature: [signature]

TENSILE

I.D. No.: 23 A+B

Temperature (°C): 93

Time In (Hr. and Date: 3PM 27-2-85

Time Out (Hr. and Date): 3PM 1-3-85

Supervisor's Signature: S.B

Q.C. Signature: [signature]

HYDROGEN DIFFUSION TREATMENT

CTOD

I.D. No.: 24 A+B

Temperature (°C): 93

Time In (Hr. and Date: 3 PM 27-2-65

Time Out (Hr. and Date): 3PM 1-3-65

Supervisor's Signature: S.B

Q.C. Signature: J Pauly

TENSILE

I.D. No.: 24 A+B

Temperature (°C): 93

Time In (Hr. and Date: 3 PM 27-2-65

Time Out (Hr. and Date): 3PM 1-3-65

Supervisor's Signature: S B

Q.C. Signature: J Pauly

APPENDIX E

WELDING DATA	DATA SHEET	WELDING PROCEDURE SPEC'N
PROCESS: Shielded Metal Arc (SMAW)	See 2-184-040-099 Series T 25-56	WPS BN18-3

MATERIAL SPEC.
CSA G40.21 - 3[illegible]WT and Lloyds LT60

POSITION 3G

PREHEAT TEMP. From RT to 120°C - See Data Sheets

INTERPASS TEMP. 230°C

ROOT TREATMENT Backgouge to Sound Metal

FILLER METAL:
TRADE NAME E48018

FLUX:
TRADE NAME & PARTICLE SIZE N/A

GAS:

SHIELDING GAS		AT	CFH
TRAILING GAS	N/A	AT	CFH
BACKING GAS		AT	CFH

JOINT GEOMETRY

T	SIDE	LAYER	PASS	AMPS ±	WIRE FEED SPEED I.P.M.	VOLTS ±	TRAVEL SPEED IPM ±	ELECTRODE DIA. mm	TYPE	ESO	POLARITY
	See attached data.							3.2 and 4.0	E48018		DC+

NOTES
Passes to be balanced on each side of tee to ensure that distortion occurring around the vertical member is balanced.

ISSUED BY	APPROVED BY	CONTRACT
G. Proulx	M. J. Tales	2-184-040/099
DATE March 84	DATE March 84	

SUMMARY OF TYPICAL WELDING PROCEDURES

The welding electrodes used were either CLA E48018 or Hobart E48018 and all electrodes were held in holding ovens at approximately 150°C before release into heated quivers (75°C min.) for use. Welding was carried out in the vertical up (3G) welding position with no restraint applied and a balanced welding technique. Two electrode sizes, 3.2 and 4.0mm diameter, were used with an average heat input of 1.4 kJ/mm (1.3 to 1.5).

A maximum permissible weave allowed during vertical welding was imposed as follows:

Electrode Dia. (mm)	Max. Weave (mm)
3.2	8
4.0	10

A stringer pass sequence was used for the capping layer along with the dime test requirement.

TABLE E1: TYPICAL WELDING SEQUENCE FOR A 25mm TEE BUTT
(Refer to Fig. E2)

PASS NO.	SIDE NO.	WELDING PROCESS	WELDING POSITION	ELECTRODE				AMPS	VOLTS	T.S. (mm)
				SIZE (mm)	TYPE	CLASSIFICATION	POLARITY			
1-2	1	SMAW	3G	3.2	CLA	E7018	DC+	115/125	20/23	110/120
3-4	2	SMAW	3G	3.2	CLA	E7018	DC+	115/125	20/23	110/120
5-6	1	SMAW	3G	4.0	CLA	E7018	DC+	160/175	20/23	110/120
7-8	2	SMAW	3G	4.0	CLA	E7018	DC+	160/175	20/23	110/120
9-10	1	SMAW	3G	4.0	CLA	E7018	DC+	160/175	20/23	110/120
11	1	SMAW	3G	3.2	CLA	E7018	DC+	115/125	20/23	110/120
12-13	2	SMAW	3G	4.0	CLA	E7018	DC+	160/175	20/23	110/120
14-18	1	SMAW	3G	3.2	CLA	E7018	DC+	115/125	20/23	110/120
19	2	SMAW	3G	4.0	CLA	E7018	DC+	160/175	20/23	110/120
20-26	2	SMAW	3G	3.2	CLA	E7018	DC+	115/125	20/23	110/120

Note: Pass sequence varied to balance heat affecting vertical member of tee. Also, a dime test requirement was imposed on weld toe.

TABLE E2: PREHEAT, INTERPASS AND AVERAGE NUMBER OF PASSES

Plate Thickness (mm)	Preheat (°C)	Interpass (°C)	Average No. of Passes
15	RT	230	11
25	15	230	26
50	70	230	55
75	120	230	120

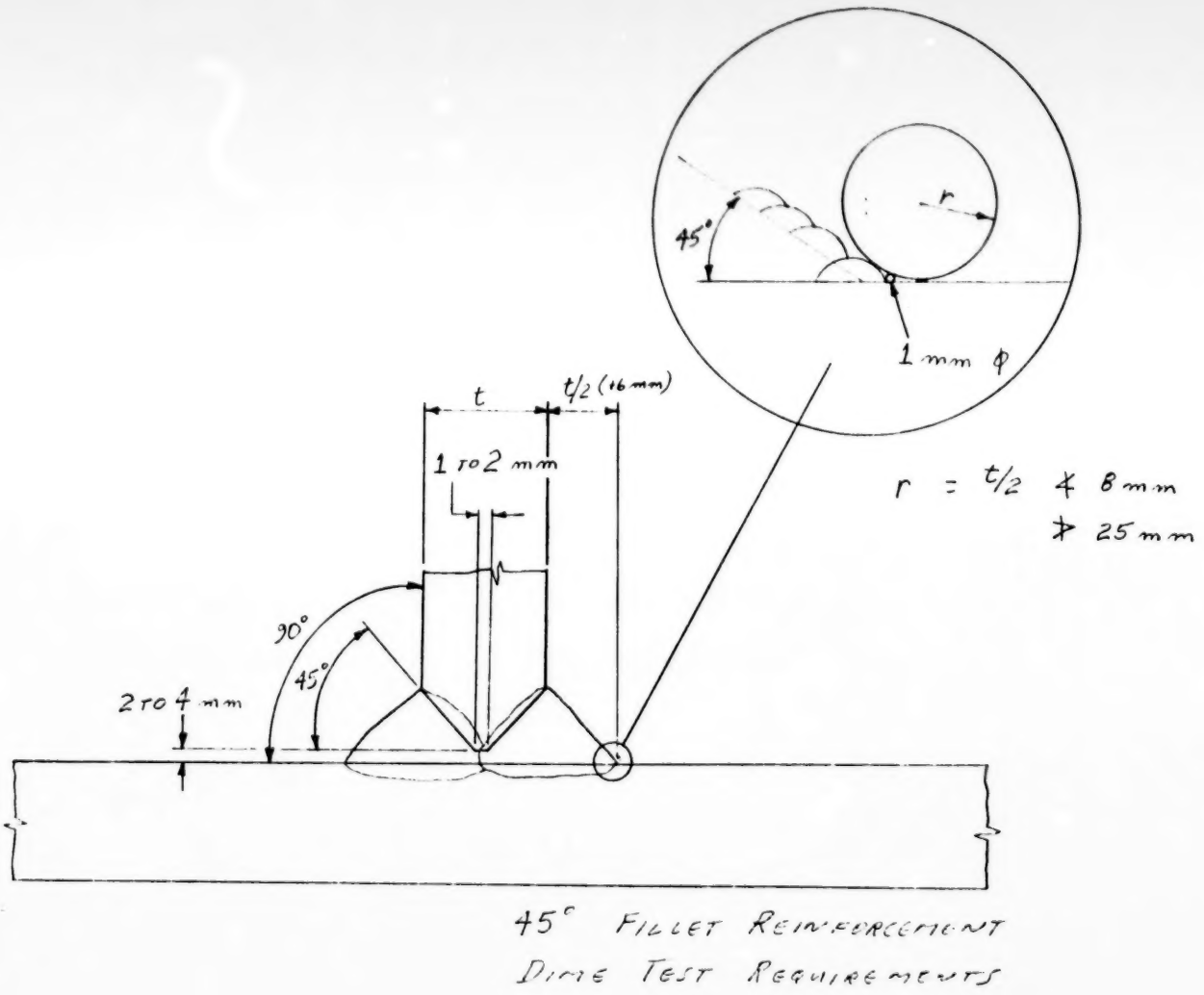


FIGURE E1: Typical lee Butt Weld Preparation and Profile

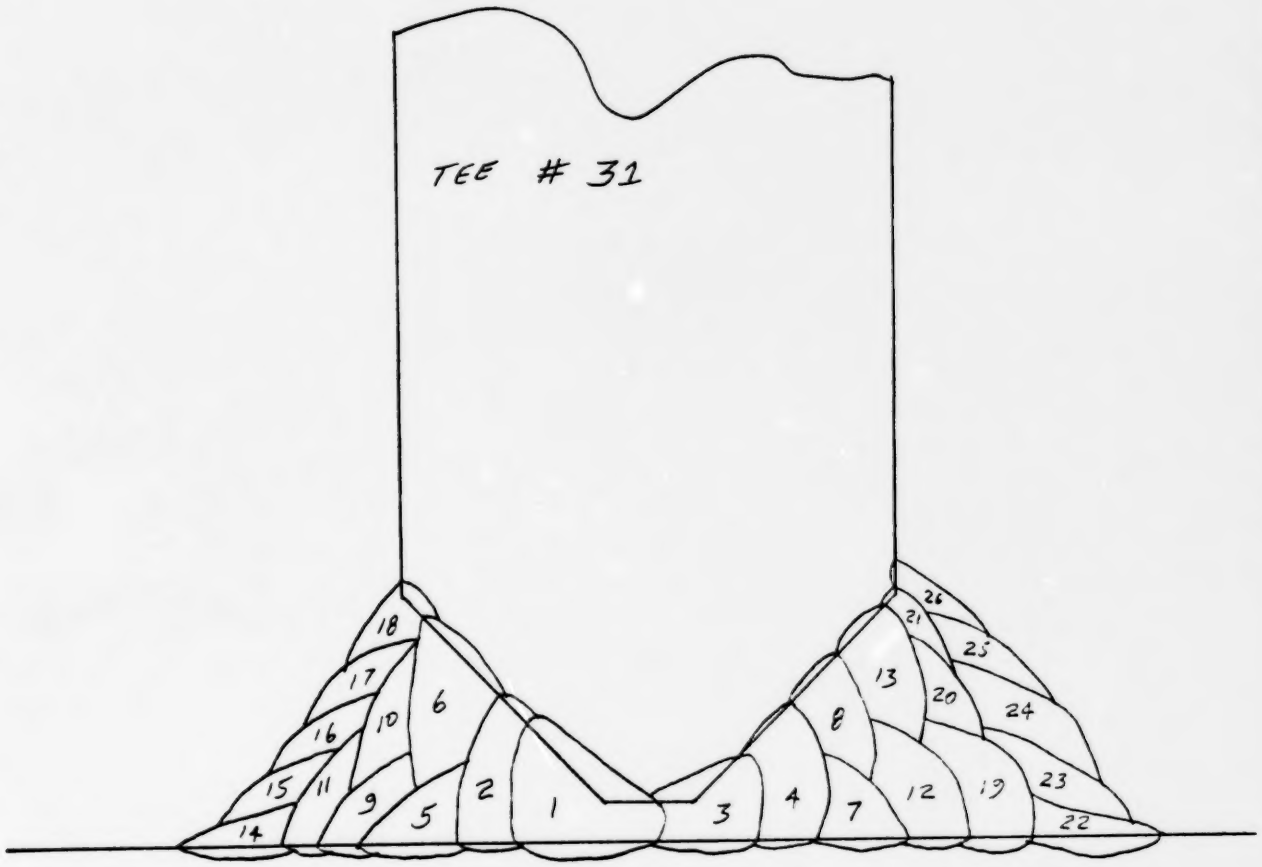
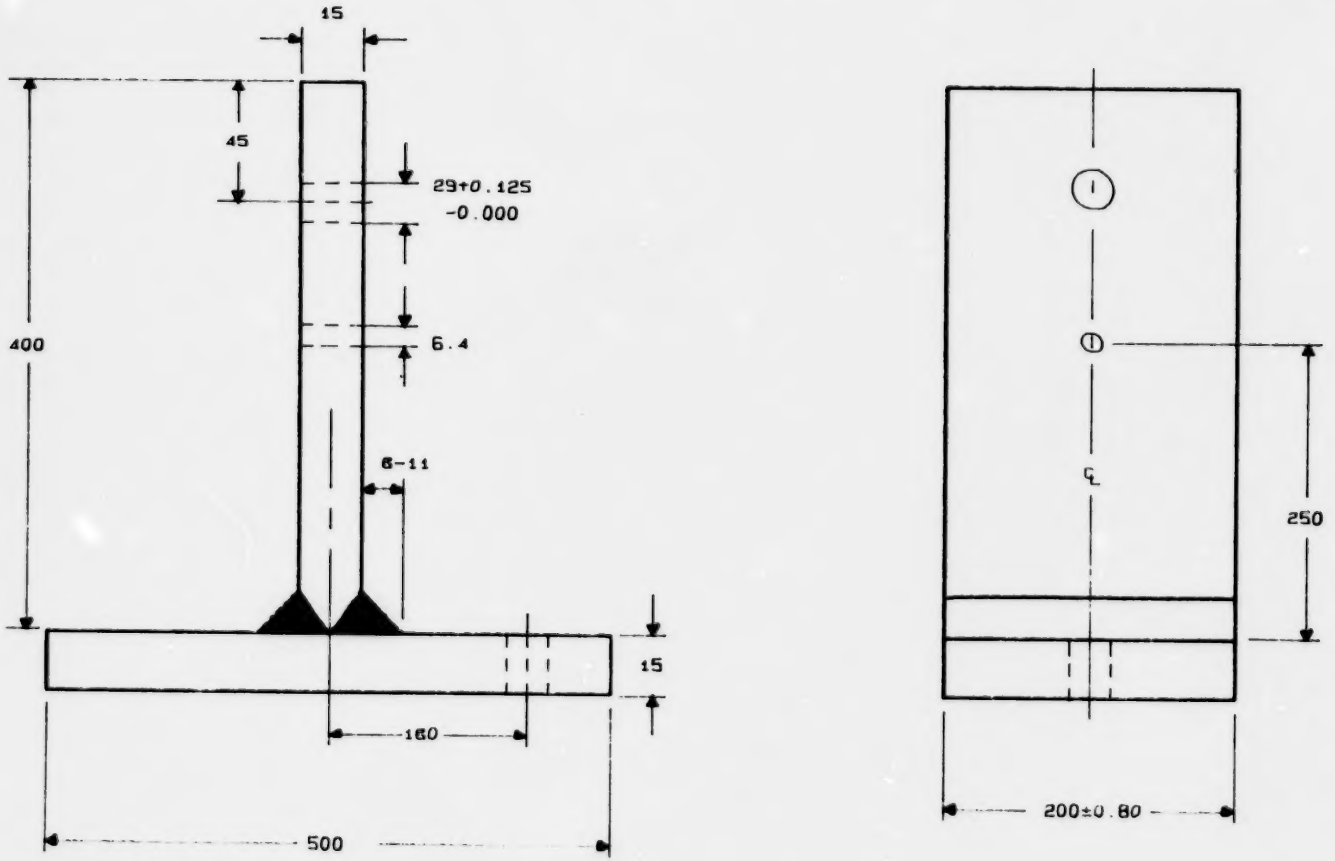


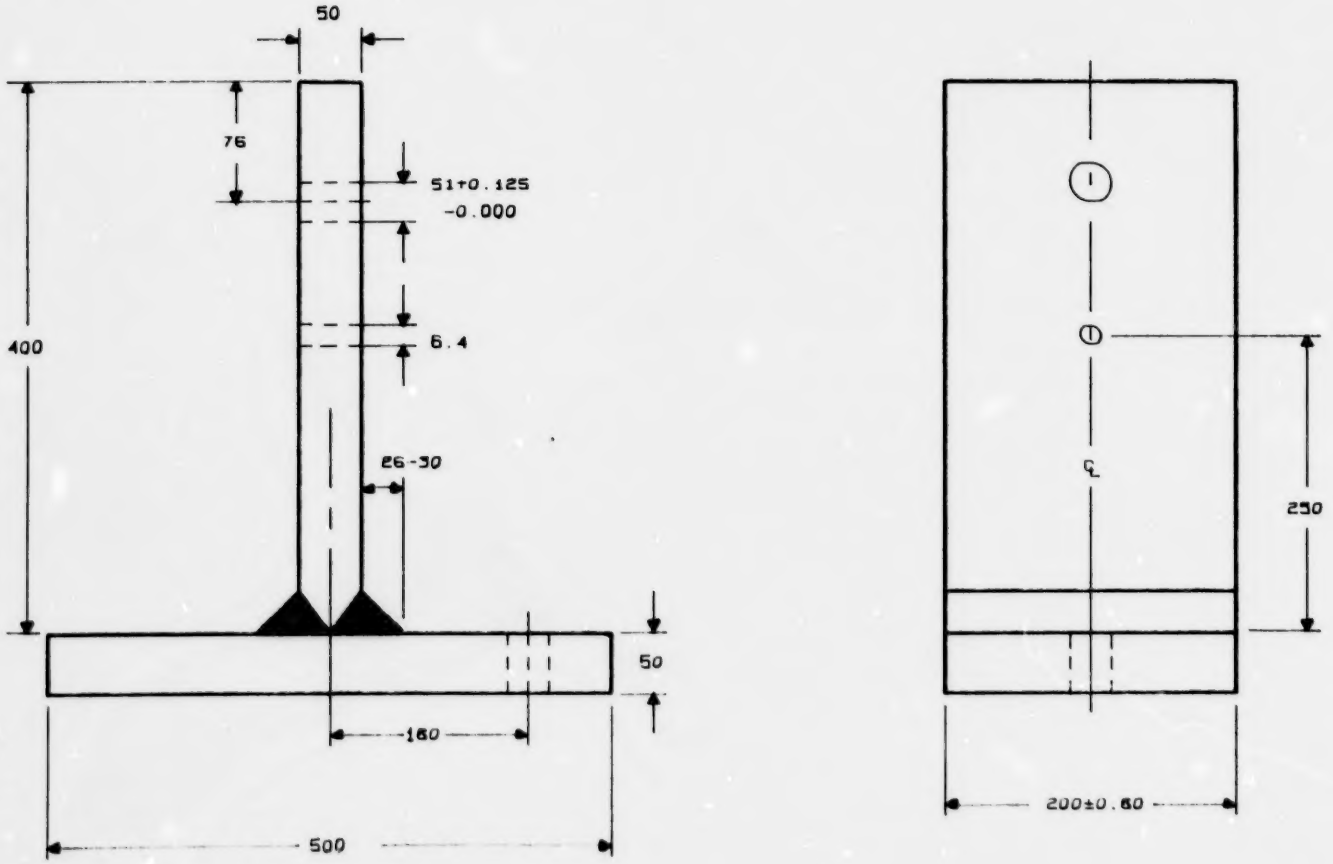
FIGURE E2: Typical Weld Pass Sequence

(25mm Plate)

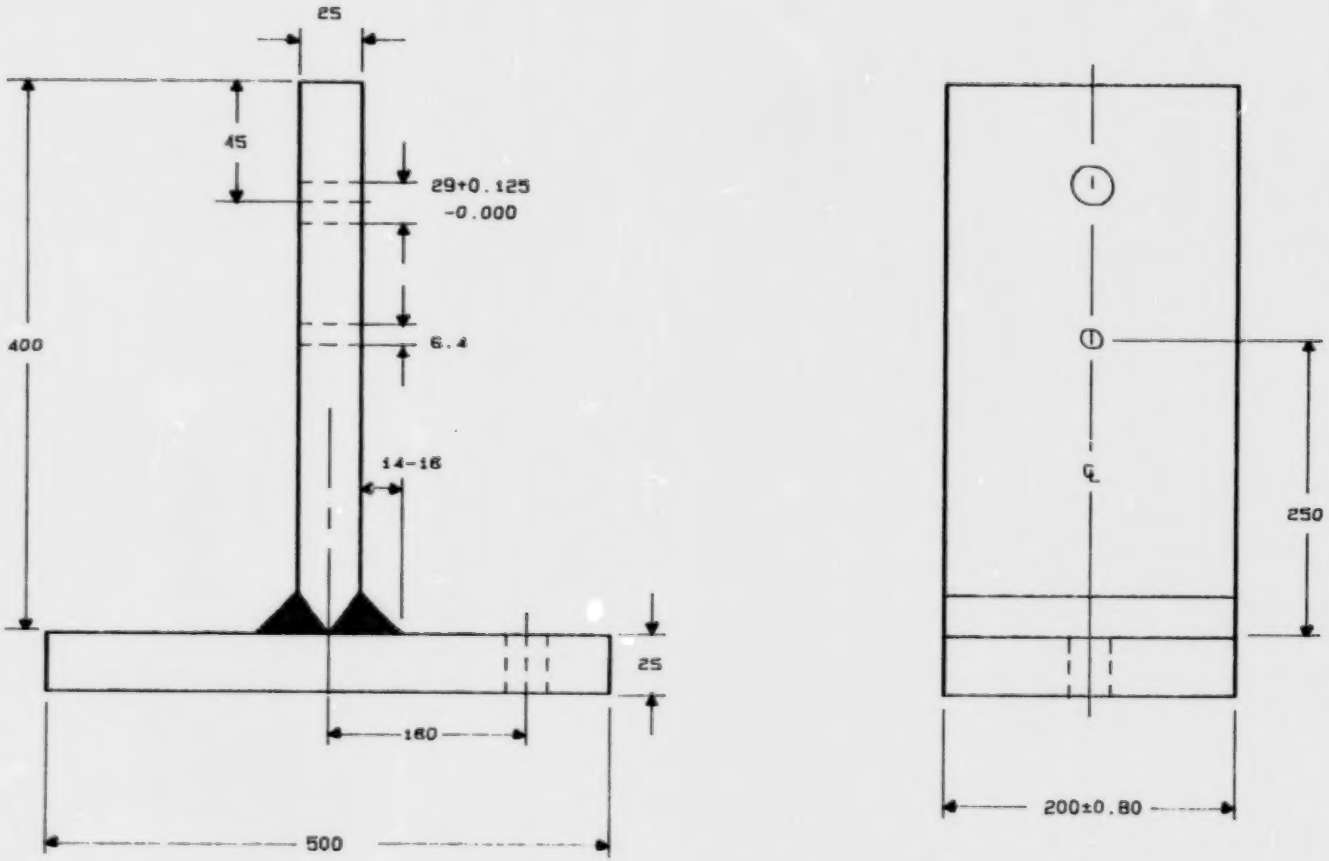
15 mm TEE BUTTS



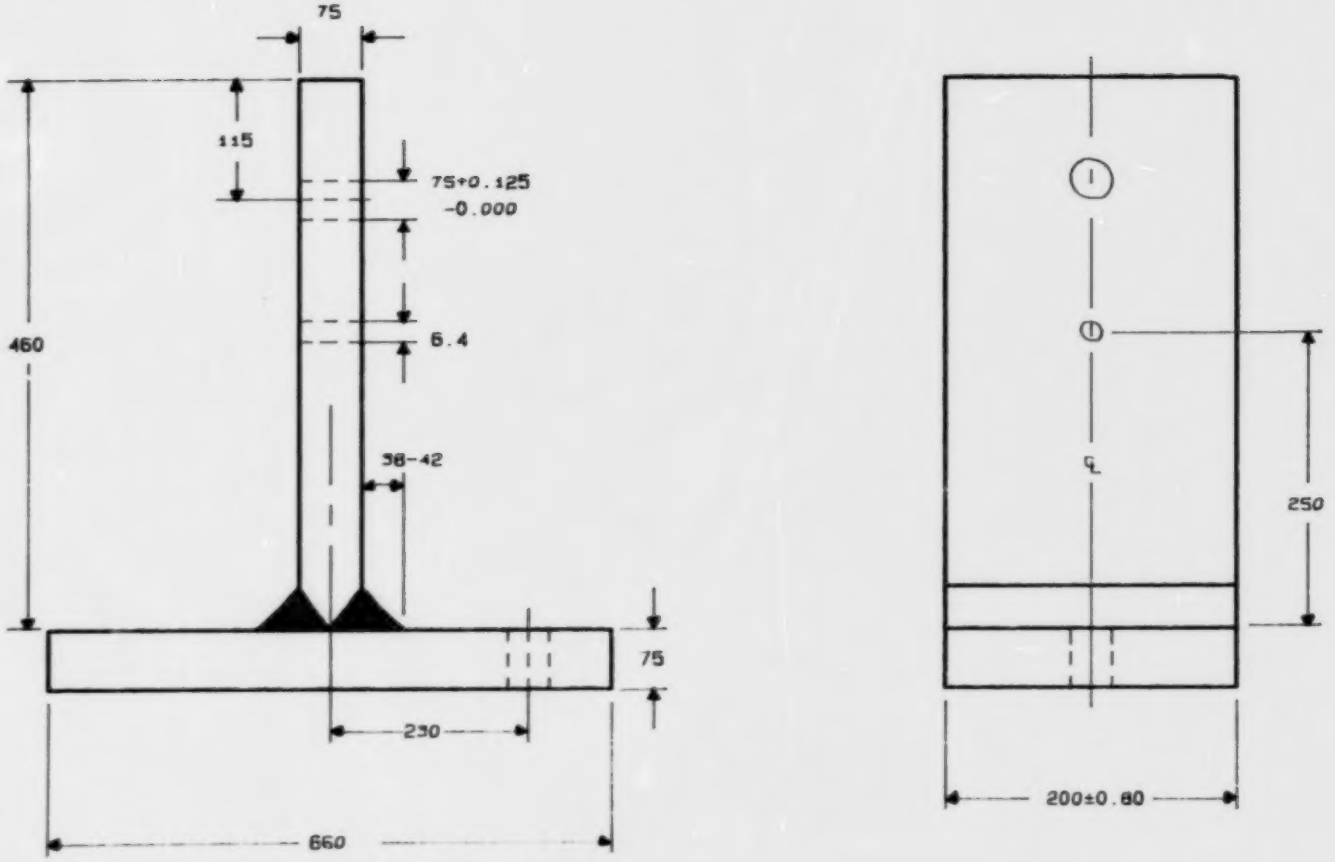
50 mm TEE BUTTS



25 mm TEE BUTTS



75 mm TEE BUTTS



100 mm TEE BUTTS